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THE LOGISTICS MANAGEMENT DECISION SUPPORT SYSTEM (LMDSS); AN EFFECTIVE TOOL TO REDUCE LIFE CYCLE SUPPORT COSTS OF AVIATION SYSTEMS?

by

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June 1998

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The LMDSS is being introduced as a tool to facilitate action by NAVAIR logistics managers to reduce the life cycle support costs of aviation systems while protecting readiness. We conclude the LMDSS does not meet the definition of a Decision Support System due to the lack of modeling capabilities. The LMDSS architecture and capabilities meet the information needs of surveyed logistics managers and support Affordable Readiness initiatives which are the means by which NAVAIR intends to reduce life cycle costs while sustaining aviation system readiness levels. Lack of modeling, graphics and sensitivity analysis capabilities limits identification, analysis and comparison of Affordable Readiness initiatives.

We recommend modeling tools and graphics capabilities be incorporated as part of the LMDSS application. We further recommend that initiatives to improve data validity be expedited and that Maintenance Level 3 detail cost data be provided. Recommendations are made for further research.

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LIST OF ABBREVIATIONS

ADP - Automated Data Processing

AIRRS - Aircraft Inventory and Readiness Reporting System

AME - Automated Maintenance Environment

APML - Assistant Program Manager, Logistics

ASN (RD&A) - Assistant Secretary of the Navy, Research and Development, Acquisition

ASO - Aviation Supply Office

AV3M - Aviation Maintenance and Material Management

AWIS - Airborne Weapons Information System

BCM - Beyond Capability Maintenance

CAIV - Cost As an Independent Variable

CBS - Cost Breakdown Structure

DCR - Detailed Component Report

DLA - Defense Logistics Agency

DRPM - Direct Reporting Program Managers

DSS - Decision Support System

FMECA - Failure mode, Effects and Criticality Analysis

FST - Fleet Support Team

GAO - Government Accounting Office

IDE - Integrated Data Environment

ILS - Integrated Logistics Support

IPPD - Integrated Product and Process Development

IPT - Integrated product Team

IS - Information System

JCALS - Joint Computer Aided Logistics

LAN - Local Area Network

LECP - Logistics Engineering Change Proposal

LMDSS - Logistics Management Decision Support System

LORA - Level of Repair Analysis

LRC - Local Routing Code

LSA - Logistics Support Analysis

MAF - Maintenance Action Form

MEASURE - Metrology Automated System for Uniform Recall and Reporting

MIS - Management Information System

NADEP - Naval Aviation Depot

NALCOMIS - Naval Aviation Logistics Command Management Information System

NALDA - Naval Aviation Logistics Data and Analysis

NAVAIR - Naval Air Systems Command

NAVICP - Navy Inventory Control Point

NAWC - Naval Air Warfare Center

NSLC - Naval Sea Logistics Command

O&S - Operating and Support

PC - Personal Computer

PEO - Program Executive Officer

PMA - Program Manager, Air

PPBS - Planning, Programming and Budgeting System

QA - Quality Assurance

RCM - Reliability Centered Maintenance

RDBMS - Relational Database Management System

RISC - Reduced Instruction Set Computer

R/S/C - Reliability/Suppootability/Cost

SALTS - Streamline Alternative Logistics Transmission System

SCR - Software Change Request

TC-DSS - Total Cost Decision Support System

TEC - Type Equipment Code

TMS - Type Model Series

UICP - Uniform Inventory Control Point

USD (A&T) - Under Secretary of Defense (Aquisition & Technology)

VAMOSC - Visibility and Management of Operating/Support Cost

WAN - Wide Area Network

WSM - Weapon System Managers

WUC - Work Unit Code

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I. INTRODUCTION

The Logistics Management Decision Support System (LMDSS) is being introduced to help Naval Air Systems Command (NAVAIR) logistics management teams reduce the life cycle support costs of aviation systems while protecting readiness. Recently LMDSS identified a "bad actor" in the F-14 aircraft avionics system. It isolated the Central Signal Data Converter (CSDC) and identified a replacement with similar functionality at a lower cost over the life of the avionics computer. A former F-14 APML stated without hesitation that the $42 million cost avoidance could not have been found without the LMDSS prototype system in place. (NAVAIR 7.0, 1997) Was this an isolated incident? Can we expect outcomes like this in the future from the LMDSS?

Operating and Support (O&S) costs, that account for 50 to 60 % of the Navy's Total Obligation Authority, are escalating as aircraft age and compete for the same limited resources. (NAVAIR TEAM, 1998) The Navy must improve business processes to reduce costs in order to secure the resources needed for investments in modernization and recapitalization. Cost-reduction initiatives are driving

program managers to treat O&S costs equal to other performance criteria.

Reducing life cycle support costs depends upon effective logistics management and planning that, in turn, depends upon tools to support decision-making. The LMDSS is a tool to reduce life cycle support costs of aviation systems. It is a Naval Aviation Logistics Data and Analysis (NALDA) Phase II application that incorporates data from existing maintenance, flight, cost and material databases into a structured decision making process.

II. NAVAL AVIATION PROGRAM MANAGEMENT AND LOGISTICS DECISION PROCESSES

A. RESPONDING TO THE POST COLD WAR PERIOD

The LMDSS is a tool designed to support the Program Managers, Air (PMAs) reduce life cycle support costs by supporting decision-making. The Navy must find ways to improve business processes to reduce costs in order to secure resources necessary to make investments in modernization and recapitalization required to carry out future missions.[1] NAVAIR is responding to the post cold war period in several ways (NAVAIR 3.6.1.1, 1998). First, by eliminating military-unique requirements and procedures that drive up acquisition costs the cost of aircraft systems and associated support is reduced. Second, new policies are removing the impediments to getting state-of-the-art technology into Navy aircraft and related systems. Advanced technology has proven a true force multiplier in the development and deployment of weapons systems (Hickock, 1997; Fox, 1997). Third, firms that traditionally produced

---

[1] See www.acq-ref.navy.mil/pdf/abc.pdf, Navy Acquisition Reform for additional readings on modernization and recapitalization efforts.

goods primarily, if not solely, for the Department of Defense are encouraged to diversify into commercial markets. Fourth, new policies and strategies are targeting the reduction of operating and support (O&S) costs. The large consumption of resources in this area threatens Navy modernization and recapitalization efforts (Hickock, 1997; Fox, 1997).

O&S costs account for between 50 and 60 % of the Navy's Total Obligation Authority (NAVAIR TEAM, 1998). These costs are escalating as aircraft age, competing with investment requirements for the same limited resources and thereby hindering improvements to infrastructure. Cost-reduction initiatives are changing the focus of program managers who must now treat O&S costs as they do any other performance criteria; systems must be affordable and supportable as well as meet operational requirements.

B. AFFORDABLE READINESS

Affordable Readiness is the means by which NAVAIR intends to significantly reduce O&S costs while sustaining requisite readiness levels. The resulting cost savings and cost avoidances can then be directed toward modernization and recapitalization. The objective is to meet required mission performance and ensure safe operations at the lowest

ownership cost. Previously the focus of program managers was centered on schedule and the projected average unit procurement cost with secondary interest on projected operations and support objectives. The shift from Design to Cost to Cost As an Independent Variable is a philosophical shift. The previous approach resulted in maximized performance at nearly any cost.[2] In general, ownership costs can be measured in terms of manpower, materials and resources. Readiness, availability, operating time, turn-around-time, and other similar metrics measure performance. Proposed Affordable Readiness Metrics are listed in Figure 1.

Affordable Readiness is a business practice with four inter-related elements: flexible sustainment, sustained maintenance planning, rightsourcing, and total cost of ownership. Appendix A describes each element. Analysis of naval aviation O&S costs reveals six major drivers that the program management team can influence by implementing Affordable Readiness: maintenance concept, inventory, manpower, technical data, infrastructure, and warranties (NAVAIR 3.6.1.1, 1998). Continuous review of in-service weapons systems to adjust the maintenance structure based on

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[2] See Land, 1997; Kausal, 1996 for a historic perspective on CAIV.

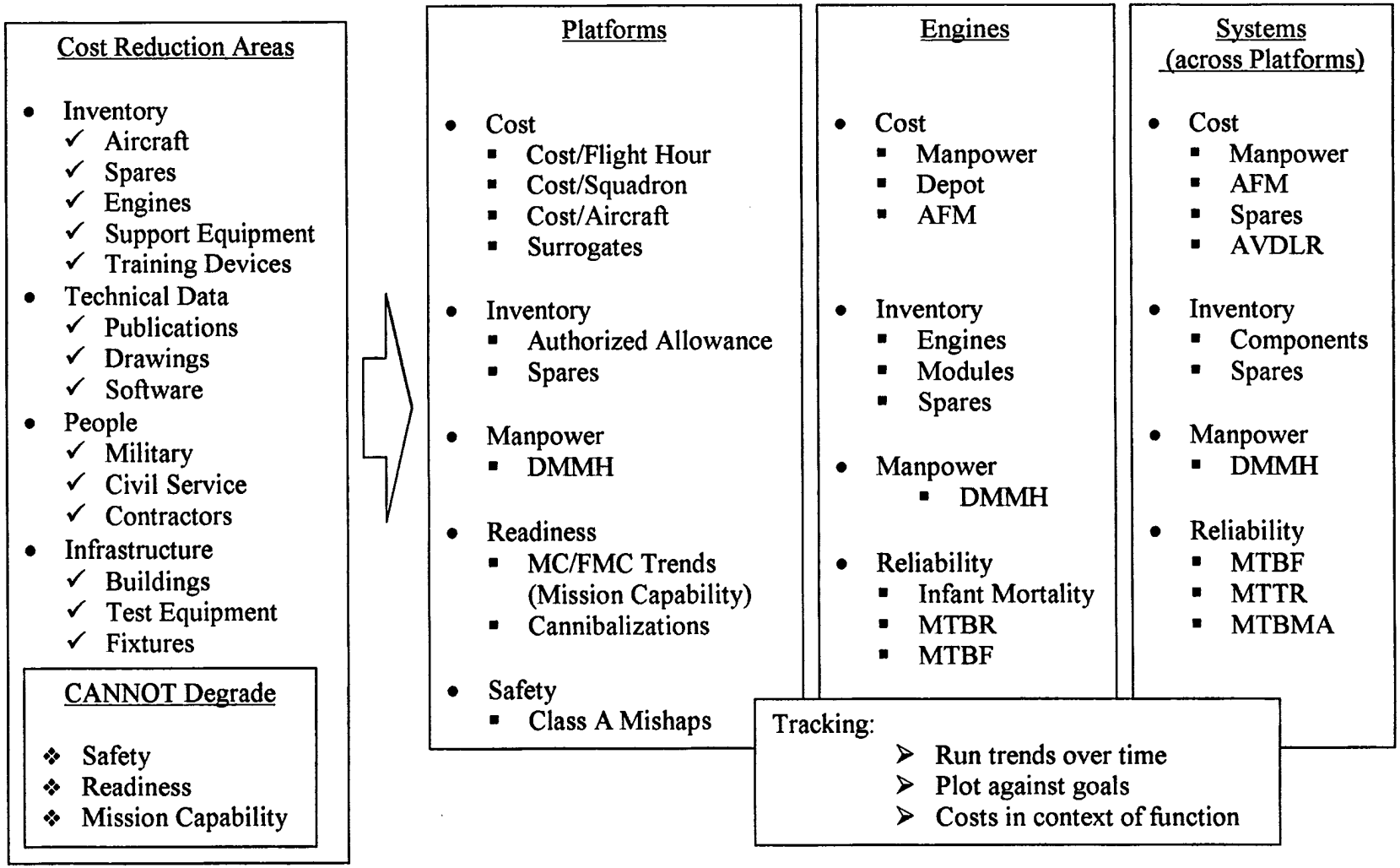

Figure 1 Affordable Readiness Proposed Metrics. After NAVAIR 3.6, Affordable Readiness Brief, June 1997 and Affordable Readiness Web Site

fleet feedback concurrently optimizes operational requirements and provides opportunities to eliminate unnecessary costly activities. Reliability Centered Maintenance (RCM)[3] analysis and Logistics Engineering Change Proposals (LECPs) processes help to achieve better inherent reliability, target technology insertions, and avoid obsolescence. Better inventory management and repair process analysis can reduce out of service time for aircraft, spares, and support equipment. Smart decisions early in the acquisition planning process can reduce material and manpower requirements to support an aircraft system throughout its total life cycle. Partnerships with industry, consolidating capabilities, the use of digitized data, single process initiatives, reinvention initiatives, reliability warranties, and integrated diagnostics are some of the many cost-effective initiatives. Program managers must make intelligent trade-offs between performance and life cycle costs. The decision support systems must *support* the PMA developing and analyzing alternatives.

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[3] See www.nalda.navy.mil, NAVAIR Logistics, Affordable Readiness Link.

C. PROGRAM MANAGER ROLE IN AFFORDABLE READINESS

Figure 2 depicts organization responsibilities as they pertain to Affordable Readiness. Affordable Readiness is a management approach being implemented within the existing organization structure.[4] The PMAs are responsible for developing plans to implement and execute Affordable Readiness; identifying specific reduction targets and metrics for tracking progress; setting priorities and making investment trade-offs; directing the actions of supporting teams like Fleet Support Teams and Integrated Product Teams; interfacing with support environments such as policy, process, facility and infrastructure organizations to develop optimal policies and processes; reporting actions taken and results; and obtaining fleet feedback on how the system is performing. Assistant Program Managers, Logistics (APMLs) advise PMAs on logistics matters. The program management office is where the rubber meets the road in life cycle management and total cost of ownership analyses. It is here that the manager who has both authority and responsibility is held accountable for effective and efficient allocation of resources. The PMA must balance

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[4] See www.navair.navy.mil, NAVAIR for additional readings on the NAVAIR TEAM history and organization.

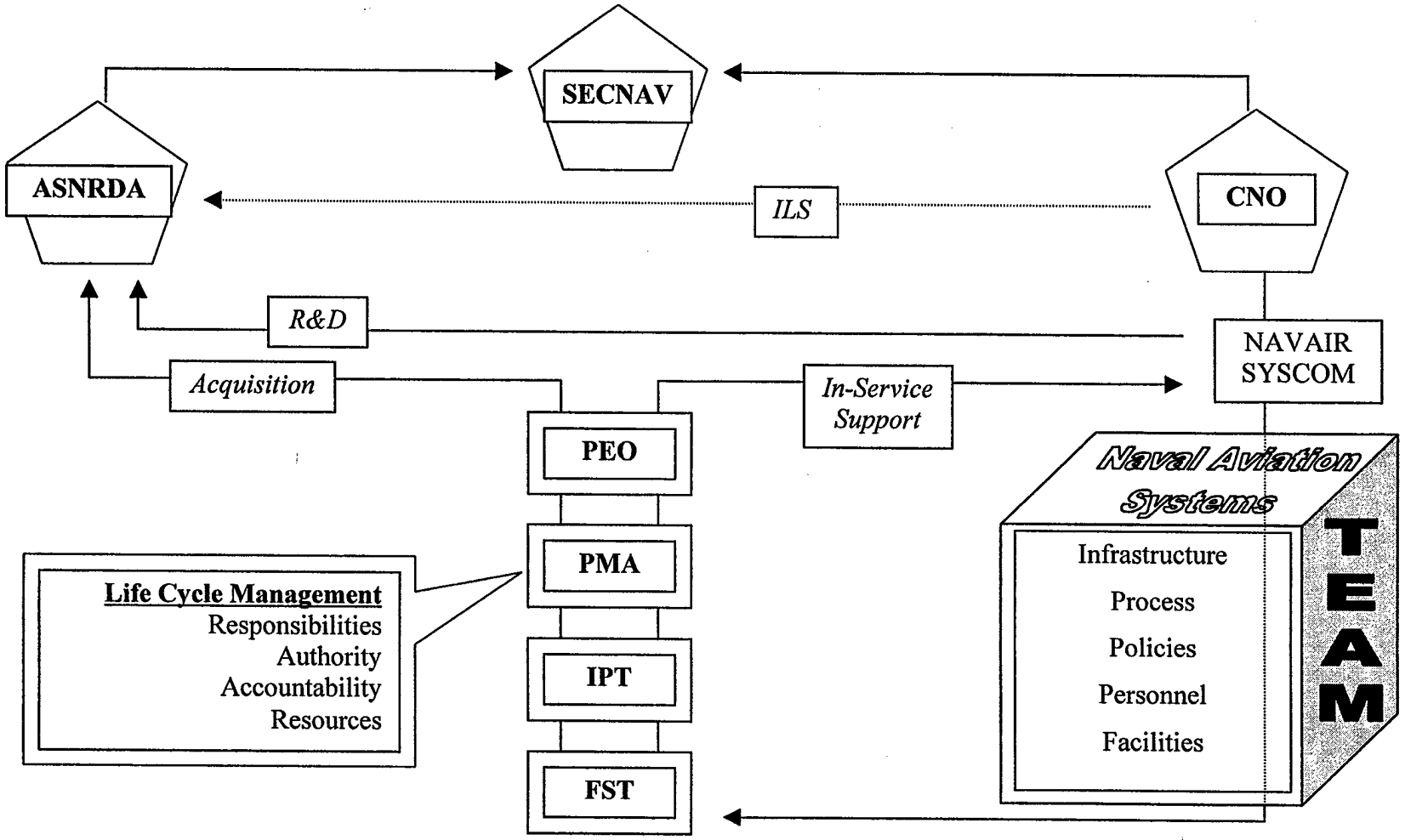

Figure 2 Affordable Readiness Organization Responsibilities. After SECNAVINST 5400.15A and NAVAIR 3.6 Affordable Readiness Brief, June 1997

short and long-term objectives and vie for critically limited resources. Additionally, he must do so while working within a labyrinth tangled with political and bureaucratic processes and pressures.

D. INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

PMAs manage within the context of Integrated Product and Process Development (IPPD) which is a management process that integrates all activities from product concept through production/field support. It uses a multi-functional team to optimize the product and its manufacturing and sustainment simultaneously to meet cost and performance objectives. IPPD evolved from concurrent engineering and the philosophies of quality management. It is a system engineering process integrated with sound business practices and common sense decision making.

Integrated Product Teams (IPTs) are the means through which IPPD is implemented. Appendix B describes the three types of IPTs. These cross-functional teams are formed to deliver a product with common performance objectives using a common approach for which they hold themselves mutually accountable. Members of an IPT represent the technical, manufacturing, business, and support organizations that are critical to developing, procuring, and supporting the

product. Team members work together to achieve the team's objectives.

E. LOGISTICIANS AND INTEGRATED PRODUCT TEAMS

As functional area experts logisticians have special responsibilities because they bring special knowledge and a special point of view to the effort. The degree to which these experts are willing to share their knowledge and point of view will determine their value to the team. In addition to providing an expert opinion, experts play an important training role on the team. By sharing their expertise, they educate fellow team members to the not-so-obvious implications of programmatic decisions and actions. Team member involvement includes active participation, effective communication, challenging requirements that do not make sense, and paying attention to detail. For the logistician, dedication to these principles can make the difference between fielding a costly, ineffective, inefficient system or an optimal one. Optimal solutions are often a result of well-researched opinions, constructive conflict resolution, and tenacity.

Because with few exceptions most of the cost of a program is in the cost of ownership, i.e. the support of the system throughout its operational life, the logistician can

make major contributions to the acquisition of a cost-effective system. While dealing with short-term problems, the logistician must also think about problems that will arise in the future. For example, increased environmental awareness and legislation has increased the difficulty and cost of demilitarization and disposal of systems. An unreliable system with poor maintenance support will drive the need to procure costly spare components that may or may not be available. Identification of such problems early in the concept exploration phase of a program can help avoid serious consequences later in the program's life cycle. The logistician's role on an IPT depends on the type of IPT it is. On a higher level IPT not directly focused on support issues the logistician should be concerned with identifying and highlighting the long-term logistics implications of various program issues. He may then form a supportability IPT to focus on mitigating the effects of those issues on the supportability of the system. At the program level the logistician should be more concerned with influencing the design of the system and the design of the support structure. An important responsibility of the logistician on an IPT is to help the team create supportability performance requirements that are quantifiable and testable so that the decision-makers can

gain insight into the operational suitability of the product and the logistic planners can plan for the support of the item.

The Fleet Support Team (FST) is an example of an IPT directed to interface with the fleet, identify problems, and develop solutions. The focus of these teams is on all aspects of life cycle support for a system from when it is fielded until it is disposed. Within the context of Affordable Readiness, the FST is the center for identifying initiatives, performing analyses, and developing action plans. The resulting action plans can include investments (Engineering Change Proposals), process improvements (consolidated maintenance activities), or innovative support solutions (commercial or joint service support equipment). IPTs, including FSTs, are not standardized. Each PMA determines how he will manage his program. Some teams are highly specialized while others cross diverse functional barriers. Some FSTs are organized within the program office while others are organized within the aircraft controlling custodian or depot maintenance engineering support organizations. Accordingly, the APML has different relationships with teams, both within and beyond the program office, as determined by individual program office organization. Additionally, program offices use a number of

different sources for logistics support. Some program managers rely heavily on Navy personnel assigned within the program office, others rely on government employees from a logistics competency group in NAVAIR,[5] while some contract out to commercial sources for logistics analyses and recommendations.

F. CHANGE FROM CHECKLISTS TO INTEGRATED FLEXIBILITY

Because acquisition program management is tailored to meet individual program needs, the challenge of supporting information systems is to gather and present data in an equally flexible manner. The data must reflect performance and supportability metrics in a meaningful, effective, and efficient way.

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[5] Within NAVAIR's matrix organization in which team members report to both a functional leader and a program leader, competency leaders are responsible for providing skilled, knowledgeable members for IPTs and for managing the processes by which these personnel support the teams. The Logistics Competency Center's mission is to provide the people, skills, knowledge, processes, facilities, and equipment required to manage and perform the planning, development, acquisition, integration, and delivery of all integrated logistic support elements necessary to affordably design, support and maintain weapons systems throughout the program's life-cycle. Supporting missions include technical publication development, logistics elements integration, affordability studies, and engineering technical services to name but a few.

Traditional Integrated Logistics Support (ILS) used a step-by-step analytical process that defined all the logistics and maintenance tasks, resources, and requirements necessary to establish and sustain an effective support program over the life cycle of a program. The logistics community depended on ILS products generated from the application of the Logistics Support Analysis (LSA) process as stipulated in MIL-STD-1388-1A. Now as DoD 5000.2-R stipulates, supportability factors are to be integrated elements of program performance specifications, but support requirements are not to be stated as distinct logistics elements. Instead they are to be stated as performance requirements that relate to a system's operational effectiveness, supportability, and life cycle cost reduction. The challenge to the PMA is to develop a performance-based statement of work that includes supportability metrics in addition to the usual operationally oriented performance goals. Programs must be able to be evaluated on specific performance metrics describing the relation of cost-of-ownership with other parameters such as mission performance, safety and availability/readiness. Appendix C describes four factors that must be considered in establishing supportability requirements.

MIL-HDBK-502 offers guidance on acquisition logistics as an integral part of the systems engineering process. The information is applicable, in part or in whole, to all types of material and automated information systems and all acquisition strategies but it is not a "cookbook" approach to acquisition logistics. It is intended to accommodate the vast, widely varying, array of potential material acquisitions and provides general guidance to logisticians on how to perform certain aspects of their jobs.
NAVAIR has a companion "Contracting for Supportability Guide." This guide identifies five steps (Appendix D) to be used to establish a supportability strategy for acquisition programs for new systems, major and minor modifications or upgrades, and commercial and non-developmental items.

III. LOGISTICS MANAGEMENT DECISION SUPPORT SYSTEM

A. HISTORY AND ORIGINAL REQUIREMENTS

The LMDSS requirement evolved from NAVAIR and Aviation Supply Office (ASO) initiatives to assess the logistics health of programs using standard metrics of readiness, supportability, and cost. In 1991, the effort was expanded into a requirement to develop a decision support system which would be the primary tool for APML/Weapon System Managers (WSMs) to achieve a "continuous, measurable reduction in life-cycle costs while maintaining operational readiness and sustainability." (LMDSS Req. Doc., 1993)

The driving requirement behind LMDSS was the need for a tool to facilitate measurement to plan and identification of targets for cost reduction. This would be accomplished through use of a software package operating on several key databases organized in a relational environment. The key to successful operation of the DSS rested with the integration of diverse databases into a central repository. This integration would result in an immediate, precise response

to queries, regardless of the type data requested or its origin.

Access to logistics data in a relational environment allowed a level of analysis that was impossible in personal computer based systems. Where analytical requirements involved databases outside the repository, access would be made automatically as a standard function of LMDSS. The repository would encompass data from all three maintenance levels, the supply community and selected sources of specialized information. To speed access, the system was to be established using both local and wide area interconnection techniques. The system was to be designed to accommodate managers and analysts who were not necessarily Automated Data Processing (ADP) experts.

The NAVAIR development team determined that to provide maximum utility, LMDSS needed to provide both a structured, modular approach and an unlimited ad hoc query capability. A requirement for an extensive repertoire of Statistical Process Control and traditional charting available on a semi-automated basis was established to compliment both of these capabilities.

The plan was for the data repository to be located at ASO to provide all Naval Aviation maintenance personnel, engineering personnel, supply personnel and procurement

personnel a "common and integrated sheet of music." (LMDSS Req. Doc., 1993). Provisions would be made to integrate Streamline Alternative Logistics Transmission System (SALTS) data with traditional Aviation Maintenance and Material Management (AV3M) reporting when available. The objective was to incorporate all necessary AV3M and Uniform Inventory Control Point (UICP) data, so that it could be manipulated directly by the logistician, to support detailed causative research. The NAVAIR development team also desired summary data, where refined and available. However, the focus was to remain on ability to support detailed research in a relational database management system environment.

The LMDSS software was to be divided logically into five modules of 1) Candidate Selection; 2) Problem Isolation; 3) Ad hoc Queries and Special Summaries; 4) Evaluation and Selection of Alternatives and 5) Implementation and Status Tracking.

The original requirements for LMDSS assumed a IBM RISC System/6000 Model 970 machine located at ASO hosting a massive - hundreds of gigabytes - database and regional IBM RISC System/6000 machines located at each Naval Aviation Depot (NADEP) and selected Naval Air Warfare Center (NAWC) activities. The regional machines would not house the extensive data held in the NALDA ASO IBM RISC System/6000

machine. The regional machines would tap the ASO database resource via remote procedure calls. Connectivity between the RISC machines would be provided by either direct connection of each RISC system to the NAVNET Internet or directly to the DDN MILNET. It would employ a client/server distributed architecture linking these computers via TCP/IP in a WAN and LAN environment. ASO LMDSS customers would directly interact and conduct X Windows client/server sessions with the ASO RISC machine via LAN and TCP/IP. All other LMDSS customers would directly interact and conduct X Windows client/server sessions with their respective regional RISC system via LAN and TCP/IP. It was planned as an information system requiring direct LAN connectivity. The original system was not planned to support PCs or workstations in stand-alone mode, nor support connectivity via modem.

All programming was to be done in Ada. The operating system for the RISC machines was to be IBM AIX and Oracle was to be the database. Rapid prototyping was used for the software development methodology. The prototype system is running on a RISC machine located at ASO.

By 1995, it was determined that Ada was unsuitable as a host language. HTML and PERL were used to request and

display reports. X Windows and C were being used for programming complex displays.

In 1996, the scope of the LMDSS underwent substantial change. The LMDSS database was expanded to essentially become NALDA Phase II (NAVAIR 3.6.2, 1998). The LMDSS did not start out as the heart of NALDA II but at that point, that is what the system became. Appendix E provides a detailed discussion of the evolution of NALDA and the composition of NALDA Phase II.

In 1997, due to contractor difficulties and equipment problems, the development team decided to convert reports to operate with commercial browsers, abandon X Windows and use Active X controls for complex reports, and move to Internet access. Additionally, they decided to transition from the IBM RISC/6000 machines to multinode IBM Scaleable POWERparallel2 (SP2) for the production platform. The SP2s will all be located at NAS Patuxent River Maryland, rather than the distributed architecture originally planned. Expectations for what the system would ultimately deliver were scaled back. Rather than being everything for everyone, core capabilities were identified, and "nice to haves" were eliminated. Those capabilities eliminated included graphic capabilities, the Return on Investment module, and ad hoc query access against the detail data.

The ad hoc query capability would still be possible using the IQ Tool - an OLAP software product. Because of the detailed knowledge of the database and SQL skills required to make effective use of this software, the tool would be available only to certain users. These users would primarily be analysts at the major claimants or the NADEPs.

B. THE CURRENT STATE OF THE LMDSS

The data load into the LMDSS/NALDA II database on the SP2 equipment is now in its final stages. When this load is complete the application will be pointed to the new tables and turned over to the Fleet as the replacement for NALDA Phase I. Automated database loading software is operational and AV3M SALTS submissions are now being loaded directly into the LMDSS/NALDA II database. Naval Sea logistics Command (NSLC) is now out of the AV3M business (NAVAIR 3.6.2, 1997).

C. THE LMDSS FEATURES AND CAPABILITIES

The LMDSS is organized into seven functional areas. The following descriptions of these areas and subareas have been derived from the LMDSS homepage:

1. Management Analysis

This module consists of various tools for displaying high level summary data for end items, claimants or organizations. These tools identify system degraders and produce reports ranked by parameter. The reports include:

- End-Item Matrix. This produces a matrix that summarizes reliability, supportability and cost data to the end-item level.
- Claimant Matrix. This produces a matrix that summarizes reliability, supportability and cost data to the claimant level.
- End-Item/Claiment Matrix. This produces a matrix that summarizes reliability, supportability and cost data to the end-item and claimant level.
- Organization Matrix. This produces a matrix that summarizes reliability, supportability and cost data to the organization level.
- Beyond Capability Maintenance (BCM) Report. This produces a report that summarizes BCM data to the organization level.

2. Candidate Identification

This module consists of various tools for displaying reliability, supportability, and cost summary parameters for

selected aviation equipment. These tools identify system degraders and produce reports ranked by parameter. The primary purpose of this module is to allow managers to identify opportunities for life cycle cost and readiness improvement. These tools include:

- Reliability/Supportability/Cost (R/S/C) Matrix. This offers a choice of three basic matrices: Component by Reported NIIN, NIIN Head of Family, and Work Unit Code (WUC).
- Common Equipment Matrix. This identifies potential problems with cross-platform components. Additionally, there are four methods for collection of equipment/systems/components that have multiple aircraft applicability:
  - Local Routing Code (LRC). This uses the ASO local routing code. This selection will only collect data for NIIN or NIIN Heads of family that match the specified LRC.
  - Type Model. This collection method is based on the minimum number of Type Models in which a NIIN must occur to be considered common equipment.
  - Type Model Series (TMS). This method is based on the minimum number of TMSs in which a NIIN must occur to be considered common equipment.

- NIIN. This selection displays the selected NIIN, its nomenclature, the Type Equipment Code (TEC)/TMS it can be found on, and the number of the selected items in the TEC/TMS.

- Emergent Problems Matrix. This identifies items that show recent changes in reliability, cost, maintenance and supply.
- Bureau Number Matrix. Displays support costs, maintenance and supply statistics, and reliability figures broken out by individual bureau number for a TMS.

3. Trend Analysis

This module consists of tools used to analyze system degraders to determine the basic problem(s) and examine the underlying cause(s). The Historical Trend Analysis tools display reports of statistics over time. This is tabular information summarized by month covering End Item or the component levels.

- Aircraft Utilization History. Presents a parameter value entry and selection form to prepare for the display of flight and utilization data that aids in historical trend analysis of aircraft.

- Work Unit Code History. Presents a parameter value entry and selection form that includes selection of WUCs, to prepare for the display of maintenance data that aids in historical trend analysis of WUCs.
- Intermediate Maintenance Activity. Presents a parameter value entry and selection form which includes input of NIIN and Date Range to prepare for the display of intermediate level maintenance that aids in trend analysis.

4. Cost Analysis

This module contains tools used to analyze end-item and component cost data.

- Annual Operations and Support Costs (AIR 4.2). Displays platform level cost information based on the OPNAV Code N889 sponsored Navy Flying Hour Program. The report can be generated for a specific TMS squadron manned at 90% or 100%.
- Budget Analysis (OP-20 Report). Displays the Budget Analysis Report selection parameters. The operator selects the fiscal year, TEC and funding command to produce the desired report.

- Labor Cost History. Displays Labor Cost History data in tabular format. Parameters of year and maintenance level may be selected.
- Inflation Factors. Displays fiscal year, inflation rate, raw index, weighted index and budget year multiplier for a variety of operator selectable appropriations categories.
- Item Value Cost Reports. Allows users to select between the Item Value to Depot Repair Cost report or the Item Value to Labor Cost report. In the Item Value to Depot Repair Cost report the user can compare the replacement value of items in the database to the cost of level 3 maintenance for a selected time period. The result is shown as a percentage showing the level 3 maintenance cost of in service units compared to the cost to replace those units. The Item Value to Labor Cost reports are similar in that they compare the replacement cost of items to the labor cost at maintenance levels 1 and 2 for those items. The results show the annual cost of ML1 and ML2 labor as a percentage of item replacement cost.

5. Detailed Analysis

This module contains tools used to analyze items identified in the Candidate Identification Function.

- Detailed Component Report (DCR). This is a comprehensive report encompassing data from all three levels of maintenance (AV3M) and supply (Weapon System File/UICP). It is designed to fault isolate candidates from the candidate identification to the root hardware cause(s) of R/S/C degradation. This is accomplished through drilling down through progressively more specific forms to lower levels of detail.
- Supply Synopsis. This section of the Detailed Component Report provides greatly expanded information covering supply and depot repair parameters.
- Source Document Report (VIDS/MAF). This section provides detailed report information of VIDS/MAFs. It is possible to drill down to and view a specific VIDS/MAF.

6. Supply Analysis

This module consists of specialized summary and forecasting reports intended for use by supply personnel.

This utility provides a means through which both readiness and cost factors are examined concurrently.

- Wholesale System Demand. This form is used to aid in forecasting demand for specific NIINs. It will link to a NIIN Analysis screen that will provide the user with a breakdown of more NIIN specific information and links to the DCR and Tools Cross-Reference report.
- Wholesale System Investment. This report is sorted by NIIN and a break out of repair costs is displayed.
- End-Item Material Issue Trends. This report can be displayed by TEC or TMS.
- Average Customer Wait Time Reports. These reports can be produced for specific TECs broken out by maintenance level, response time crossed with COG or the highest wait days across all NIINs for that TEC.
- Wait Time Maintenance Impact. Under Development
- Average Days to Receipt. Under Development
- Backorder History Report. Allows for the display of data for TEC/TMS sorted by NAVICP Material Type and Data Elements. The report may also include DLA Supply Center and Data Elements.

- Backorder Ranked Report. This report allows for identification of the NIINs with the largest number of backorders against them.
- Planned vs Actual Opportunity Cost. This form allows the user to enter source of reliability data to report on from NAVICP, LSAR, or Manually Entered.
- Mean Flight Hours Between Failures Report. This form and resulting report can be used for "what if" analysis. Planned data can be entered and then compared to actual data.
- NAVICP NSN Snapshot. This report may be generated for a specific NIIN. Either a summary report or a report specific to backorders, stock status, alternate NIIN, etc. may be produced.
- Repair Cycle Report. Gathers and displays data on repair cycle and BCM rates.

7. Engine Analysis

This module consists of tools that allow the analyst to view projected actual costs and hours for different engines.

- Depot Engine Repair Cost. This provides the analyst with historical information on the cost, funding source, and activity for each engine. This report is not accessible to contractors.

- Engine Overview. The overview report expands the information available to include engine inventory, a cost breakout and the capability to select data covering all TMSs for specific TMSs, all sites, PAC sites or LANT sites.
- Engine Removal Analysis. Tracks average engine time since last repair when removed. The repair site and the number of engines attributed to that specific site are also listed.
- Engine Removal Trend. Charts the engine removals to TMS based on 100-hour service intervals since last repair. Multiple series may be compared on the same chart, giving insight into factors such as "infant mortality" and "high time."
- Top Reasons for Removal. Displays the top reasons for engine removals to TMS.
- Flight Hours Since Last Repair. This is a companion report to the Engine Removal Trend Report. In addition to charting removals by TMS, it also shows the reason for each removal along with flight hours in 100-hour increments.
- Flight Hours Since Repair at Removal. Displays engine removals and maintenance man-hours. This

report differentiates between scheduled and unscheduled maintenance, and displays average hours.

- Engine Demand Forecasting. Based on the premise that evolving reliability and maintainability data, both historically derived and imposed, must be considered in conjunction with historical demand for successful engine demand forecasting. This option derives from historical files and extrapolates past performance to future needs through application of relative flying hours.

8. Reference Information

This module consists of tools that provide general aircraft information, definitions, statistics, assistance, reference information/reports, and information about the application/database.

9. Application Management Tools

Contains various utilities that provide current database status, user identification, server status, and the Software Change Request form.

10. Feature Synopsis

This provides a brief description of the modules and links to the sub-elements.

The LMDSS has an on-line Help capability. Each input form has an accompanying Help function that explains the input fields. Additional links within some of the Help screens provide information on algorithms used to derive the reports. Other links provide definitions of acronyms and computer jargon.

D. QUALITY ASSURANCE (QA) PLAN

Prior to the transition from the NALDA I to NALDA II database, a systematic series of tests to ensure proper functionality, accuracy and a smooth transition is planned. The two primary targets of this testing are to assure accurate data retrieval throughout the application and database integrity.

Sections of the application and certain derived data in the Oracle tables where problems have been previously identified are being re-coded. Concurrent with this effort, the QA team, composed of analysts conversant with LMDSS and NALDA I will go through each section of the LMDSS application in a critical review of form, format, and accuracy of content.

The prototype application software currently in use is identical to that which will operate against the SP2s. This

means that quality assessment can begin immediately. There are specific challenges that must be addressed:

1. Data Outputs are not Identical

Although the database which LMDSS now reaches is based on a data pull from NALDA I, the data outputs are not identical. This is because in LMDSS, the data pre-processing has been improved to provide greater accuracy. Examples of the differences include use of aircraft versions in addition to TMS and revised item count logic. This makes comparative analysis difficult, but not impossible.

2. Software Change Requests System

The problem is that the reporting system, which was built into the client-server version of LMDSS, became inactive during the transition to the Internet based version. It has been two years since a Software Change Request (SCR) has been classified, scheduled or answered. This has resulted in a lack of systematic documentation of problems and resolutions during the transition (Jones, 1998).

The SCR system is again working. All SCRs and their status can be viewed under the Application Management Tools Module of the LMDSS application. An examination of the current list of SCRs indicates that there has been significant progress made on the application validation.

E. ANTICIPATED ADVANTAGES

The development team anticipates that the LMDSS will provide an important analysis function to assist logistics managers in establishing requirements for new acquisitions as well as troubleshooting existing weapon systems. Because of the Integrated Data Environment (IDE), the LMDSS will allow all potential user levels to substantially reduce the amount of time required to identify and analyze problems in logistics support.

The LMDSS will provide an ability to analyze data concerning common equipment - those items that are used on more than one weapons platform. The present approach essentially looks at present conditions and backordering philosophies that encourage a tunnel vision approach due to difficulty in identifying common components that can be used across platforms/weapon systems in correlating maintenance/repair and ordering of specific common equipment.

With the implementation of the LMDSS, daily feeds of maintenance and flight data will be received through SALTS terminals directly to the production database. The current system uses a monthly update cycle based upon the NSLC processing schedule that establishes data as 45 days old as

the best case. Monthly reports will be available at least 30 days earlier under the new system. Data quality will also be improved with the strengthening of validation specifications at the source and use of "most probable logic" within the data summarization function of the database. (NAVAIR 7.0, 1997)

IV. LITERATURE REVIEW

A. THE DECISION SUPPORT SYSTEM AREAS OF RESEARCH

Much of this DSS research can be classified into one of five areas:

1) what distinguishes the DSS from other computer information technologies;
2) whether the DSS actually improves decision quality or performance;
3) identifying specific design characteristics and the impact they have on the DSS development;
4) the role of the decision-maker and how differences between individuals and organizations can influence the effectiveness of the DSS; and
5) DSS evaluation methods.

1. The DSS Versus Other Computer Information Technologies

The first area of research has addressed what distinguishes the DSS from other computer information technologies. Currently, there is a general consensus that a DSS is composed of the following three interrelated components: data management, model management, and dialogue

management components (Alter, 1977; Sprague, 1980; Keen, 1981). Each component provides specific capabilities to a decision-maker and improves the effectiveness with which he or she works.

The data management component should include:

1) the capture and extraction of data into a database;
2) the storage, retrieval, and control of data by a database management system;
3) the ability to interact with data from internal and external sources;
4) the ability to perform ad hoc queries; and
5) the flexibility to allow rapid additions and changes in response to unanticipated user requests. (Alter, 1977; Sprague, 1980; Keen, 1981)

The model management component of DSS provides a user with a set of capabilities that differentiate it from other traditional computer systems. These capabilities include:

1) the use of multiple models to support diverse problems;
2) the support of semi-structured and unstructured problems;
3) the ability to build models quickly and easily;
4) the ability to track models through a model directory;

5) the ability to integrate models with appropriate links through the database; and

6) the creation, retrieval and storage of models handled by a model base with management functions analogous to database management. (Alter, 1977; Sprague, 1980; Keen, 1981)

The dialogue management component provides the mode of interaction between the user and the DSS. Research results suggest that a well-developed interface should include:

1) the support of multiple dialog styles;

2) the capture, storage, and analysis of dialogue through a dialog management system;

3) the ability to interact with the model and data components of the DSS; and

4) the support of multiple methods of presenting output to provide for a variety of formats and media, and the flexibility for different users' knowledge base. (Alter, 1977; Sprague, 1980; Keen, 1981)

2. DSS Benefits

The second group of studies has primarily focused on benefits that the DSS provide. The primary justification for the development of a DSS is that it will be a value to the decision maker (Hogue and Watson, 1983). Some studies

in this area support the premise that the DSS improves decision quality or effectiveness (Sprague and Watson, 1986; Hogue and Watson, 1985; Sprague and Carlson, 1982; Keen and Scott Morton, 1978). In other studies there was no effect, and in still others decision quality worsened when a DSS was employed (Benbasat and Nault, 1990; Sharda, et al., 1988). A DSS provides a coherent strategy for going beyond the traditional use of computers in structured situations where measures of effectiveness and efficiency are nearly equivalent.[6] In the semi-structured and unstructured situations in which the DSS is used, effectiveness has been the primary focus. Other research suggests that it is efficiency that is actually improved (Todd and Benbasat, 1992).

The DSS is designed to be an interactive system used by managers with little experience in computers and analytical methods to help improve the effectiveness and productivity by supporting, rather than replacing, judgment (Fedorowicz and Manheim, 1986). A DSS is, in effect, an assistant to whom the manager delegates activities involving retrieval,

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[6] Efficiency is performing a given task as well as possible in relation to some predefined performance criterion. It is a measure of resources utilized against results derived. Effectiveness involves identifying what should be done and ensuring that the chosen criterion is relevant. It is the degree to which a goal is achieved.

computation, reporting, and development of alternatives. A manager evaluates the results and chooses the next step. The benefits the DSS provides are often not quantitative. Benefits include the ability to examine more alternatives, stimulate new ideas, improve confidence in the decisions, reduce the probability of error, improve communication of analysis, and speed up decision making. (Keen and Morton, 1978; Keen, 1986; Hogue and Watson, 1985; Hogue and Watson, 1983)

3. Design Characteristics

The third area of DSS research has been directed towards identifying specific design characteristics and the impact they have on the DSS development. Topics investigated have included the impact of different presentation formats, the use of color, the influence of different graphics capabilities, and the influence of different user interfaces. Analysis has generally provided mixed results as to the impact of these factors on decision-making effectiveness (Bennett, 1983; Pearson and Shim, 1994). This is not to infer that a DSS that is more easily accessible, as with a web browser, does not provide measurable benefits. Intuitively, the more accessible the design interface, the more positive the impact will be on decision-making effectiveness. Because internet browser

technology has only been introduced since the mid 1990's, there is a lack of research into the relative effectiveness of this interface versus others.

4. The Role of Individual Decision-Makers and Organizations

The fourth group of studies has addressed the role of the decision-maker and how differences between individuals and organizations can influence the effectiveness of DSS. Research includes theoretical studies of organizational decision-making. Specific characteristics investigated include cognitive biases and processes, novice/expert effects, models of decision-making, and user-situational variables (Mittman and Moore, 1984; Mann et al., 1986; Keen and Morton, 1978; Alavi and Joachimsthaler, 1992). User-situational variables include user involvement, training and experience. The emphasis in this area is on describing the methodologies and differences of decision-making so that computer technologies can be effectively prescribed and applied to improve how decisions are made. Research has also found that MIS success is dependent upon the extent to which it fits the organizational environment (Raymond, 1990; Ein-Dor and Segev, 1978; Ein-Dor and Segev, 1982; Schultz and Slevin, 1975).

5. The DSS Evaluation Methods

The last major area of research is that of measuring the implementation success of the DSS. Implementation success refers simply to realizing the intended benefits of the system. Currently, no single approach to the definition of DSS implementation success exists in the literature. A variety of different variables have been proposed and tested as indicators of success. These include such things as system use, decision-making time, decision-making performance, user satisfaction with the system, user confidence in the decisions, and user attitudes towards the DSS. (Alavi and Joachimsthaler, 1992; Money et al., 1988; Raymond, 1990; Lee et al., 1995; Swink, 1995; Goodhue, 1995; Gatian, 1994)

The evaluation of DSS is a research direction mentioned by almost every author in this field, but measuring the effectiveness of these systems is a difficult task (Udo and Davis, 1992). Again, the literature indicates little or no consensus as to a model or methodology for evaluating success. Those proposed have progressed from the traditional cost-benefit analysis (King and Schrems, 1978) to techniques that attempt to include the intangible and qualitative benefits of the DSS.

First among these is Value Analysis (Keen, 1981; Money et al., 1988). An important premise of this approach is that the perceived benefits of the DSS are significant determinants in justifying a specific DSS.

Keen and Scott Morton (1978) advocate a smorgasbord approach to determining effectiveness. Eight methodologies to be matched to a specific situation are proposed. These include examining decision outputs; changes in decision process; changes in managers' concepts of the decision situation; procedural changes; classical cost/benefit analysis; service measures; managers' assessment of the system's value; and anecdotal evidence.

Adelman (1992) suggests that an eclectic approach is required to test and evaluate DSSs effectively. He defined three alternative types of evaluation procedures: objective measurement, expert observation, and subjective judgment. Any one or combination of these methods could be used depending upon the system and what the system was to achieve.

A fundamental aim of an organizational information system (IS) is to improve individual decision-making performance, and ultimately organizational effectiveness. The difficult in empirically assessing system effectiveness in this way has led researchers to adopt surrogate

constructs that are more easily measured. Of the two main approaches for evaluating IS success, the first one is behavioral and focuses on systems usage. This approach is often used in empirical research (Baroudi et al., 1986; Gremillion, 1984; Hogue and Watson, 1985; Raymond, 1985). Here the implication is that if the information system helps improve decision quality, then the end user will use the system.

The second approach in evaluating success centers on user attitudes, more specifically on user satisfaction with various aspects of an information system (Lee, et al., 1995; Gatian, 1994; Swink, 1995; Hogue and Watson, 1985). End user IS satisfaction is the extent to which users believe the system meets their information requirements (Ives, et al., 1983). IS satisfaction is assumed to be a good substitute for objective determinants of information system success. The basic idea is that satisfied users should perform better than dissatisfied users and if the IS helps users perform better, the system is successful (Gatian, 1994).

Other research, going beyond the user satisfaction with the system, has focused on satisfaction with information quality. Gatian's (1994) findings support the theory that

availability of relevant information improved decision performance.

Yet another method that has been proposed looks at the process. This methodology attempts to trace the effects of the system through all stages of the decision process. The focus is on the outcomes of the process and its individual steps (Vetschera and Walterscheid, 1995).

We believe that a combination of these methods is necessary to determine the success of a system. A model that combines the process orientation with the information quality methods is that of task-technology fit (Goodhue, 1995). The essence of this model is that task-technology fit is presumed to lead to higher performance. Systems that provide information necessary to a user's tasks, at the right level of detail, clearly and unambiguously will be highly valued. We intend to take this research one step further and apply it to a specific DSS.

B. MEASURING LIFE CYCLE COSTS

The LMDSS has been identified as a tool to reduce life cycle costs (LMDSS Req. Doc., 1993). In this section we provide a review of literature to support the significance of measuring life cycle cost versus alternative program measures.

The recent combination of economic trends, rising inflation, products and system cost growth, the continued reduction of buying power, and budget limitations has increased the awareness and interest in total system cost. Not only are the acquisition costs associated with new systems rising, but the costs of operating and maintaining systems already in use are increasing at alarming rates (NAVAIR TEAM, 1998; Hickock, 1997). The requirement to increase overall productivity in a resource-constrained environment has placed emphasis on all aspects of the system or product life cycle. In the past, total system cost has not been readily visible, particularly those costs associated with system operations and support. As these cost elements are increasingly visible through computerized tracking and activity-based costing, they can more readily be managed. Further, when addressing total cost, experience has shown that a major portion of the projected life-cycle cost for a given system or product is a result of the consequences of decisions made during the early phases of program planning and system conceptual design (Blanchard, 1992). Decisions at this point have a major impact on activities and operations in all subsequent phases of the life cycle.

Blanchard (1992) relates the cost visibility problem to the "iceberg effect." The acquisition cost of research, design, test, production, and construction are visible above the water. The mass of the iceberg below the surface illustrates additional, less visible costs such as:

- operations cost (personnel, facilities, utilities, and energy);
- product distribution cost (transportation, traffic, material handling);
- software cost (operating and maintaining software);
- maintenance cost (consumer service, supplier factory maintenance);
- test and support equipment cost;
- technical data cost;
- supply support cost (spares, inventory, material support);
- training cost (operator and maintenance training);
- retirement and disposal cost.

The greatest opportunity to influence total cost, which is predominantly made up of the costs illustrated as those costs below the water, is during the early phases of a program. Decisions relating to the evaluation of

alternative operational use profiles, maintenance and support policies, equipment packaging and transportation schemes, and level of repair concepts have a great impact on total cost. An overarching goal is to field high-quality products, systems, and structures in response to established needs. It is through a concurrent life-cycle approach that managers can deal with all economic factors (Fabrycky and Blanchard, 1991) and recognize the life-cycle implication associated with almost all decisions. Efficient and effective decisions result from analysis of the total program (cost, performance, schedule, and political elements) relative to the total life cycle (concept design and requirements planning, design and development, production, utilization, and retirement/disposal). Product or system life-cycle analysis can be applied to the evaluation of numerous alternatives, including:

1) operational scenarios and utilization approaches;
2) system maintenance concepts and logistic support policies;
3) design configurations, technology applications, built in test versus external test, reliability versus maintainability, or levels of repair versus discard decisions;
4) supplier sources;

5) number of inventory points and levels of inventory, transportation and handling methods;

6) inspection and test policies; and

7) product recycling and disposal methods. (Fabrycky and Blanchard, 1991)

We follow Fabrycky and Blanchard (1991) in holding that an important first step in the analysis is clarifying the analysis objectives. It is important to define the issues of concern and bind the problem such that the study can be efficient. Too large an effort can become overwhelming and it is easy to proceed in the wrong direction. The problem must be defined clearly, precisely, and presented in such a manner as to be easily understood by all concerned. Otherwise, it is unlikely an analysis of any kind will be meaningful. Within the established bounds and constraints, all possible alternatives should be considered, with the most likely candidates selected for further evaluation. Alternatives not considered cannot be adopted; therefore, it is better to consider all candidates even those that do not seem attainable or likely rather than overlook one that may be good.

One of the greatest challenges facing industry, government agencies, the Department of Defense, and the general consumer of products and services is the growing

need for more effective and efficient management of our resources. The Department of Defense logistics mission is "to provide responsive and cost-effective support to ensure readiness and sustainability for the total force in both peace and war." (USD(A&T), 1998) The fact that logistics costs incurred during the operating and support phase are such a large part of total cost requires logistics to assume a major role during operational use. Given the cause-and-effect relationships between early planning and later costs, logistics has become equally significant in every phase of the life cycle. For these reasons research, design, production, logistics, and system performance analyses must be addressed early, concurrently performed, and integrated throughout the system or product life cycle.

The above discussion demonstrates the value of measuring life cycle costs and the value of logistics in life cycle cost analysis. The challenge then becomes how to measure and evaluate logistics performance. Good measurements should cover all aspects of the process being measured, be appropriate for each situation, minimize measurement error, and be consistent with the management reward system (Menzer and Konrad, 1991). Fabrycky and Blanchard (1991) recommend the cost breakdown structure (CBS) to provide a framework for defining life-cycle costs and communicating links for

cost reporting, analysis and cost control. CBS is a way of classifying costs with the classification being life-cycle oriented. The CBS links objectives and activities with resources, and sets up a logical subdivision of cost by functional activity area and major element of a system. It can be used as a basis for assessing the life-cycle cost of each alternative being considered. In logistics management, as with other management decisions, optimal solutions are often based on more than simply the financial bottom line. First and foremost systems must measure up to operational demands. The decisions that support those demands must also be fiscally responsible.

V. DATA COLLECTION TECHNIQUES AND METHODOLOGY

A. CONDUCT OF THE STUDY

Several techniques are commonly used to obtain perceptions, opinions, and judgments from subject matter experts. These generally fall into two categories: personal interviews and questionnaires. (Adelman, 1992) Both of these techniques were employed in the course of this study. Telephone interviews were conducted with logistics managers. These interviews were directed and structured, but allowed for open-ended responses in a number of specific areas.

A structured questionnaire and copy of the interviewer's notes from the telephone interview were sent to each respondent after the telephone interview. Included were self addressed and stamped envelopes for the surveys to be mailed back. We also used follow-up e-mail and telephone calls in an effort to improve the response rate.

We were also fortunate enough to be able to spend a week at NAVAIR. During that time, we were able to conduct face-to-face interviews with the PMA representatives that we had been unable to reach by telephone. Additionally, we

were afforded extensive briefings on the LMDSS capabilities, structure, data elements, development and history.

B. THE SAMPLE

We selected logistics managers as targets for our study. This group has been specifically identified by the LMDSS development team as the targeted users of the LMDSS. There are a total of twelve aircraft types, support equipment, and engine program management teams considered relevant to the study.

The primary target within each PMA was the Assistant Program Manager for Logistics (APML). In some cases, we were referred to the deputy APML, Product Support Team Leads or other support logisticians due to schools, retirement, travel or simply to provide yet another perspective.

C. QUESTIONNAIRE DEVELOPMENT

Our goal was to develop a questionnaire that ascertained the task-technology fit. In order to develop a questionnaire that assessed the appropriate areas a pre-study was conducted. We reviewed checklists and instructions used by logisticians, interviewed three logisticians and examined the LMDSS data elements.

The nature of this DSS evaluation was specific. Because we wished to elicit responses on the usefulness of system characteristics specific to the LMDSS, not an abstract system, an off-the-shelf survey instrument was not considered appropriate to our needs.

A four part instrument was prepared. The first part was to be conducted as an interview with the logistics manager. This section was designed to elicit information about the tasks, decision environment/process, and information needs of the logistician.

The next three parts were designed to be filled out by the respondent. Part Two was to be filled out by current users of the LMDSS. It called for responses in Likert-type-scales. See Appendix F. Questions were separated as to general logistics concerns and specific LMDSS queries. Additionally, user evaluation of specific LMDSS functions and data was requested.

Part Three was designed for non-users of LMDSS. This section was identical to the general logistics concern section of Part Two. In addition, a checklist of possible reasons for not using the LMDSS was presented with direction to check all that apply.

Part Four was applicable to both users and non-users of the LMDSS. This section also employed Likert-type scales to

elicit responses on job information needs. Listed were the information elements supported by the LMDSS. The respondent was asked to rate the usability of each element.

Since this instrument had not been validated by previous research, we pretesting the survey with experienced logisticians. Based on their remarks, we made minor improvements before conducting the phone survey and then mailing the questionnaire to participants. The questionnaire is available in Appendix F.

D. DATA ANALYSIS STRATEGY

The survey results consisted of frequency, capacity, satisfaction or usability ratings assigned to 166 individual factors by survey participants. Data were compiled from the eight survey forms and entered into the Microsoft Excel spreadsheet program.

For each question a frequency of total respondents selecting a particular rating was recorded. Trends in the data (that is, rank orderings) were determined instead of making direct comparisons of adjacent ratings, due to the small sample available for the survey.

VI. FINDINGS

A. APML QUESTIONNAIRES

Table VI-1 lists the APML point of contact by title and the method by which data was received. Of the twelve total aircraft, support equipment, and engine program management teams considered relevant to the study we were successful in communicating with nine. The results of the written questionnaire are provided in Appendix G. Seven of the eight written questionnaires received were from non-users of the LMDSS. We interviewed the E-2C APML and EA-6B APMLs but did not receive a completed written questionnaire. They both do not use the LMDSS directly, but receive reports from data analysts who use the LMDSS and other tools. All respondents are aware of the functions of the LMDSS.

The APMLs were selected as targets for our study. This group has been specifically identified as the targeted users of the LMDSS. We were referred to additional analysts and logistics specialists by eight of the nine APML representatives interviewed as a result of non-standardized organization of the PMA offices and non-standardized logistics input. Six of nine logistics managers interviewed

employ civilian contractors to provide reports and analyses. Two of nine use NAVAIR logistics specialists.

PMA	Aircraft System	Point of Contact	Method of Contact
PMA-222	Electronic Warfare and Simulation, Aircraft Engine and Special Mission Aircraft	NA	Not contacted due to retirement of APML
PMA-225	H-3, T-2, A-4	Logistics Management Specialist T-2/A-4	phone interview and written questionnaire
PMA-226	H-46, C-130, F-4	NA	Not contacted - could not locate good phone number
PMA-231	E-2, C-2	APML E-2C	Personal interview
PMA-234	A-6/EA-6 Intruder/Prowler	APML EA-6B	phone interview and partial written questionnaire
PMA-241	F-14 Tomcat	Deputy APML	phone interview and written questionnaire
PMA-260	Aviation Support Equipment	PMA	phone interview and written questionnaire
PMA-261	C/MH-53E and Executive Transport Helicopter	APML H-53	phone interview and written questionnaire
PMA-265	A F/A-18 Hornet	APML	phone interview and written questionnaire
PMA-276	Light/Attack Helicopter	Deputy APML for H1 upgrades	phone interview and written questionnaire
PMA-290	Maritime Surveillance Aircraft (MSA)	Logistics Management Specialist, P-3	Personal and phone interview; written questionnaire
PMA-299	H-2/H-60 Multi-Mission Helicopter	NA	APML away at school.

Table VI-1 PMA Points of Contact

Six of nine respondents work with both new aviation systems and sustaining existing systems. One works only with new aviation systems and two work only with sustaining existing systems. Table VI-2 shows the frequency and capacity respondents work with a number of tools while

performing their job. Table VI-3 shows the frequency and capacity with which respondents interface with project engineers, analysts, those who influence the budget, and others while performing their job.

The responses of the single respondent who uses the LMDSS is provided in Table VI-4, Table VI-5, and Table VI-6 that summarize the user-unique questions. The responses of the non-user respondents to non-user unique questions are summarized in Table VI-7.

All responses are included in the data in Table VI-8 Experience With Data Sources Other Than LMDSS, Table VI-9 Logistics Concerns, and Table VI-10 Job Information Needs.

B. RDBMS OR DSS?

In Chapter IV (Lit Review) we presented a detailed DSS definition. A comparison of the LMDSS with this definition leads to the following findings:

1. Data Management Component

The LMDSS fully meets these component criteria. The NALDA II Oracle RDBMS creates an IDE with multiple data sources. Ad hoc query capability - while limited to certain users - is available.

2. Model Component

The LMDSS has no modeling capability. The LMDSS does

TOOL	FREQUENCY OF USE						CAPACITY OF USE			
	never	infrequently	monthly	weekly	daily	don't know	identify requirements	analyze requirements	both	don't know
Logistics Support Analysis (MIL-STD-1388)	3	4	1	0	0	0	1	1	2	1
Raw Data	0	0	0	1	7	0	0	1	6	1
Models	4	0	0	0	2	1	0	0	3	1
Checklists	3	0	0	0	4	0	0	0	4	0
Intuition/Experience	0	0	0	0	8	0	0	1	7	0

Table VI-2 Logistics Management Tools

	INTERFACE FREQUENCY						CAPACITY			
	never	infrequently	monthly	weekly	daily	don't know	identify requirements	analyze requirements	both	don't know
Interface with project engineers	0	0	0	0	1	0	0	1	7	0
Interface with project analysts	0	0	0	0	1	0	0	1	6	0
Interface with those who influence the budget	0	1	0	0	0	0	0	0	4	3
Interface with others:										
Depot Maintenance	0	0	0	1	3	0	0	0	4	0
Publication Coordinators	0	0	0	1	1	0	0	0	2	0
Type Commanders/ Functional Wings	0	0	0	1	2	0	0	0	3	0
NAVICP	0	0	0	1	3	0	0	0	4	0
Suppliers (commercial, organic)	0	0	0	0	3	0	0	0	3	0
Integrated Logistics Support specialists	0	0	0	1	3	0	0	0	4	0
Contracts Office	0	0	0	1	0	0	1	0	0	0

Table VI-3 Logistics Management Interfaces

THE LMDSS QUERY	FREQUENCY OF USE
Summary data; End item	daily
Reliability summary parameters	daily
Supportability summary parameters	daily
Cost summary parameters	daily
Trend analysis (problems and causes)	daily
Component and/or end item cost data; specifically:	
Annual Operations and Support Costs	daily
Labor Cost History	daily
Item Value to Depot Repair Cost	daily
Budget Analysis (OP-20 Report)	infrequently
Inflation Factors	infrequently
Item Value to Labor Cost	infrequently
Candidate Identification Function specifically:	
Detailed Component Report	daily
Wholesale System Demand	infrequently
Material Issue Trends	daily
Supply Synopsis	infrequently
Wholesale System Investment	infrequently
Average Customer Wait Reports	infrequently
Backorder History Reports	infrequently
NAVICP NSN Snapshot	daily
Mean Flight Hour Between Failure Report	daily
Engine Repair Cost	infrequently
Flight Hours Since Last Engine Repair	infrequently
Engine Demand Forecasting	infrequently
Engine Overview	infrequently
Reference Information, specifically:	
Aircraft Inventory and Fatigue Life	infrequently
Code Definition	infrequently
Aircraft Engine Installation and Ownership	infrequently
Production Load and Run Statistics	infrequently
Possible Courses of Action	infrequently
Organization Codes/Job Count	daily
NIIN/CAGE/Part Number Cross Reference	daily
TEC Information	daily
SALTS File Information	infrequently
Data Dictionary	infrequently

Table VI-4 The LMDSS Queries

FUNCTION	RESPONSE
Interface	like
Help Function	like
Analysis Tools	like
Report Presentation/Format	like
Time Required to get what is needed	dislike
Ease of getting what is needed	dislike
Training	strongly dislike
Accessibility (when desired)	neutral
Accessibility (server access)	neutral
Accessibility (password access)	like
Provides information needed	like

Table VI-5 The LMDSS Functions

EXPERIENCE	RESPONSE
Data meet needs	agree
Data accessible	agree
Data accurate/consistent	strongly disagree
Data detailed enough	agree
The exact data meaning is clear	disagree

Table VI-6 Experience with the LMDSS Data

	NUMBER OF RESPONSES
Didn't know it existed	2
PC won't support the LMDSS	1
Received no training	4
Don't need the information the LMDSS provides	0
It takes too long to get what is needed	0
It's too difficult to get what is needed	0
It doesn't provide the information needed	2
Other: Not developed for logistics (everyday) issues yet	1

Table VI-7 Why the LMDSS is not used

	RESPONSE					
EXPERIENCE	*strongly disagree*	*disagree*	*neutral*	*agree*	*strongly agree*	*don't know*
Data meet needs	0	4	0	2	8	0
Data accessible	0	1	3	2	6	2
Data accurate/consistent	0	1	3	4	5	1
Data detailed enough	0	2	3	5	3	1
The exact data meaning is clear	0	4	2	3	3	2

Table VI-8 Experience with Data other than the LMDSS

LOGISTICS CONCERN	FREQUENCY OF USE						CAPACITY OF USE			
	never	infrequently	monthly	weekly	daily	don't know	identify requirements	analyze requirements	both	don't know
Logistics criteria as input to systems design	0	3	2	0	3	0	2	1	5	0
Human factors concerns	0	5	1	0	2	0	1	3	4	0
Failure mode, effects, and critical analysis	0	5	0	1	2	0	1	2	5	0
Failure reporting, analysis, and corrective-action system	0	2	2	2	1	1	1	1	5	1
Provisioning needs/alternatives	0	1	2	2	2	1	1	1	5	1
Compatibility with existing system	0	2	1	1	3	0	0	2	4	1
Configuration Management	0	3	0	2	3	0	0	2	6	0
Training and training support	0	1	3	2	2	0	1	1	6	0
Manpower and personnel	0	3	4	0	1	0	2	3	3	0
Supply Support, spares	0	1	0	3	4	0	0	1	7	0
Inventory level analysis	0	2	2	2	2	0	0	1	6	1
Transportation, packaging or storage	0	5	0	2	1	0	1	1	5	1
Test equipment	0	1	3	2	2	0	1	1	6	0
Support equipment	0	1	2	2	3	0	1	1	6	0
Computer resource support	0	3	2	2	1	0	2	1	4	1
Facilities, requirements	0	5	2	1	0	0	0	2	6	0
Facilities, location	0	6	2	0	0	0	2	2	3	1
Data, reports requirements	0	0	1	2	5	0	0	1	7	0
Maintenance planning (scheduled versus unscheduled)	1	2	0	2	3	0	0	2	5	0
Level of repair analysis (O versus I versus D level)	0	4	0	2	2	0	0	1	7	0
Operating environment issues	0	3	2	2	1	0	0	2	6	0
Cost-drivers	0	2	3	0	3	0	0	2	6	0
Readiness degraders	0	2	1	1	4	0	1	1	6	0
Cycle time to repair components	0	3	2	1	2	0	0	1	6	1

Table VI-9 Logistics Management Concerns

JOB INFORMATION ELEMENT	HOW USEFUL IS THE INFORMATION ELEMENT? Not at all Useful	Not Useful	Neutral	Slightly Useful	Extremely Useful	Don't Know
Summary data; End item	0	0	0	2	4	1
Summary data; Claimant	0	0	2	1	2	2
Summary data; Organization	0	1	0	1	5	0
Summary data; BCM Report	0	1	0	2	4	0
Reliability summary parameters	0	0	0	1	6	0
Supportability summary parameters	0	0	0	1	5	1
Cost summary parameters	0	0	0	1	6	0
Emerging problems	0	0	0	0	7	0
Common Equipment	0	0	0	1	4	2
Trend analysis (problems and causes)	0	0	0	1	5	1
Component and/or end item cost data; specifically:						
Annual Operations and Support Costs	0	0	0	0	7	0
Labor Cost History	0	0	0	0	7	0
Item Value to Depot Repair Cost	0	0	0	0	5	2
Budget Analysis (OP-20 Report)	0	0	1	2	3	1
Inflation Factors	0	0	1	3	2	1
Item Value to Labor Cost	0	0	0	2	3	2
Candidate Identification Function; specifically:						
Detailed Component Report	0	0	2	0	4	1
Wholesale System Demand	0	0	1	4	1	1
Material Issue Trends	0	0	1	2	3	1
Supply Synopsis	0	0	1	1	4	1
Wholesale System Investment	0	0	1	3	2	1
Average Customer Wait Reports	0	0	1	3	3	0
Backorder History Reports	0	1	1	2	3	0
NAVICP NSN Snapshot	0	1	0	2	4	0
Mean Flight Hour Between Failure Report	0	0	0	1	5	0
Wait Time Maintenance Impact	0	0	1	2	3	1
Average Days to Receipt	0	0	1	3	3	0
Planned versus Actual Opportunity Costs	0	0	1	2	2	2
Engine Repair Cost	0	0	0	0	5	1
Flight Hours Since Last Engine Repair	0	0	0	1	4	1
Engine Demand Forecasting	0	0	1	0	4	1
Engine Overview	0	0	1	1	2	2
Engine Removal Trend	0	0	1	0	4	1
Flight Hours Since Engine Repair at Removal	0	0	1	0	3	2
Reference Information, specifically:						
Aircraft Inventory and Fatigue Life	0	1	1	1	3	0
Code Definition	0	0	1	2	2	1
Aircraft Engine Installation and Ownership	0	1	1	1	2	1
Production Load and Run Statistics	0	0	1	4	1	1
Possible Courses of Action	0	0	1	0	4	2
Organization Codes/Job Count	0	1	2	2	2	0
NIIN/CAGE/Part Number Cross Reference	0	0	1	2	4	0
TEC Information	0	0	1	3	3	0
SALTS File Information	1	0	3	1	0	2
Data Dictionary	0	0	0	4	1	2

Table VI-10 Logistics Management Information Elements

offer a module entitled Trend Analysis. This module provides historical data in tabular format. Historical data is also presented in a format that could support time-series forecasting. This is found in Engine Demand Forecasting in the Engine Analysis module, and Wholesale System Demand in the Supply Analysis module. Also within the Supply Analysis module are two subareas that can accept manual entries in some parameters. This allows for a degree of "what if" analysis for Mean Flight Hour Between Failures Report and Planned vs Actual Opportunity Cost. However, there is no sensitivity analysis capability available to support the "what if" analysis.

3. Dialogue Management Component

The LMDSS meets, to some degree, all of the criteria of this component. The browser interface and hyperlinks offer navigational flexibility. Usage of the OLAP tool provides an additional degree of flexibility. Output either can be to the screen in HTML format or can be e-mailed to the requester in a format that can be imported to a spreadsheet application. There is no graphics capability.

C. DATA QUALITY

In the course of this study, three data quality issues were identified.

1. Data Accessibility

The IDE improves accessibility of data. The LMDSS/NALDA II database reduces the necessity of querying multiple disparate databases to retrieve relevant data for analysis. An economic analysis undertaken as part of the NALDA II Milestone III approval process found that the new system will allow all potential users to substantially reduce the amount of time required to identify and analyze problems in logistics support by incorporating data from as many as nine other disparate databases which are currently used for analysis. A cost avoidance of $2 million is expected over the life cycle of the LMDSS. In the area of Common Equipment Analysis, there is a potential cost avoidance of $19 million. The IDE allows for performance and reliability of specific components across the whole spectrum of Naval aircraft to be ascertained. This data accessibility did not exist prior to the LMDSS. (NAVAIR 7.0, 1997)

There is, however, misunderstanding on the part of many logistics representatives of this data accessibility. A perception exists that the LMDSS and NALDA II will hamper or eliminate the analyst's ability to access detail data (NAWC AD 3.0B, 1998). The Support Equipment PMA believed that the Cost Analysis capability would be inadequate for their needs

because cost data from DLA was not included. A review of the external interface data for NALDA II indicates that extensive DLA cost data will be available (Capstone, 1997).

2. Data Consistency

Data consistency has two aspects. Consistency between data retrieved under NALDA I and NALDA II, and consistency between modules in the LMDSS.

Although the database which the LMDSS now reaches - NALDA II - is based on a data pull from NALDA I, the data outputs are not identical. This is because in the LMDSS, the data pre-processing has been improved to provide greater accuracy. Examples of the differences include use of aircraft versions in addition to TMS and revised item count logic.

Currently, there are identified inconsistencies between the LMDSS modules. These are being addressed through the on going quality assurance process (Jones, 1998; SCR Sub-module, LMDSS application).

3. Data Validity

Data validity was a concern expressed by 75% of survey respondents and interviewees. The general perception was that data validity was currently poor and would continue to be poor.

One example that was offered by the SE PMA to illustrate this issue related to Maintenance Level 1 (organizational level), Maintenance Action Forms (MAFs) for tow tractors.

- 47% of MAFs recording down time due to Awaiting parts had no failed parts documented
- 32% of MAFs attributed the failed part to the part number of the tow tractor
- 272 MAFs recorded removal and replacement of the tow tractor part number.

Problems like this arise, in part, because finding the correct work unit code (WUC) or part number can be a time consuming task. Busy maintainers memorize a few key WUCs and part numbers and use those regardless of the real discrepancy. Lack of training on the importance of data validity may also contribute.

Another example was offered by the logistics management specialist for the S-3 aircraft. A data query to identify readiness degraders resulted in identifying the airframe as the top system degrader. Further investigation showed this was a result of how scheduled maintenance washes were being documented in an aircraft squadron. Additional stories were prevalent of the adverse impact of the use of inaccurate type equipment codes (TEC) or WUC on MAFs by maintenance

technicians who do not understand how the data is used. Seasoned data analysts know where to look to find erroneous data and know how to remove misleading data from logistics management reports. These data validity problems are caused by poor documentation at the source. This problem is currently being addressed by improved Validation Specifications at the input point of NALCOMIS.

A second data validity area is cost data. The maintenance cost data is incomplete. Maintenance Level 3 (depot) was described during one interview as a "black hole." The only aircraft cost data for ML3 in the database is aggregate cost. It is not broken out by TMS. Engine overhaul cost data - what ML3 charges the fleet - is available by TMS. The LMDSS database has placeholders for detailed cost data, but that data is currently unavailable from the depots. This precludes total cost visibility.

A final area of concern with data validity is the new SALTS processing procedures. When NSLC had cognizance of the SALTS data, a "scrubbing" process was used. Five areas of the detail data received from the fleet activities were compared with a 79 Record. If there were a 10% or greater discrepancy all detail data from that activity would be rejected.

Under the new system, the data will not be scrubbed prior to being loaded into the database. The rational for this change is two fold. First is the belief that there is more value to the analysts in having all of the data even if a small percentage of them are in error. Under the old processing system, when data were rejected the fleet activity had to correct the data and then resubmit. It could take up to three months before the detail data was integrated into the database. Second is that the Most Probable Logic feature used when summarizing the detail data will identify and correct these errors.

VII. DISCUSSION

A. APMLS AS USERS

We selected the APMLs for our study because this group has been specifically identified as the targeted users of the LMDSS. Of the twelve total aircraft, support equipment, and engine program management teams considered relevant to the study we received seven complete responses and two partial responses. The partial responses were a phone and a personal interview without completion of the written questionnaire. Additionally, we conducted personal and phone interviews with logistics advisors and the LMDSS program representatives.

Our data collection was limited by two constraints. The LMDSS is a prototype system and is not yet widely used, and the APML is only one of many potential users we subsequently identified during the course of our research. Because the tasks and needs of different users vary greatly, the information derived from the study of APMLs cannot be used to interpret the needs of other population groups without considerable risk. We identified the following user groups as equally important as AMPLs to logistics input to

aviation program management decisions: IPT data analysts, FST data analysts, and Type Commands data analysts. These analysts may be Navy data analysts, government employees, or civilian contractors assigned within the teams.

As previously discussed, program management and the logistics input thereto are not standardized. Each PMA determines how he will manage his program. The organization may primarily be within the program office, the aircraft controlling custodian, or the depot maintenance engineering support organizations. Additionally, program offices use a number of different sources for logistics support. Some program managers rely heavily on Navy personnel assigned within the program office, others rely on government employees from a logistics competency group in NAVAIR, while some contract out to commercial sources for logistics analyses and recommendations. Furthermore, PMAs must interface with support environments such as policy, process, facility and infrastructure organizations to develop optimal policies and processes; report actions taken and results; and obtain fleet feedback on system performance. All of these activities point to additional users of naval aviation logistics data and the LMDSS.

When describing the APML job, respondents commonly referred to designing, developing, or analyzing support

infrastructures for aircraft and aircraft systems. LTCOL Wiechowski, H-53 APML, referred to this job task as the "care and feeding" of the heavy lift helos. The support infrastructure is not limited to logistics concerns. As presented in Table VI-3, logistics managers interface frequently (daily or weekly) with project engineers, project analysts, those that influence the program budget, and others to both identify and analyze requirements.

B. THE LMDSS USE

As presented in Table VI-7, the following reasons were most frequently cited for why the LMDSS is not used.

- Received no training - 40%
- Didn't know it existed - 20%
- It doesn't provide the information needed - 20%

Training is a critical issue. Many studies of information technology deployment in organizations have found that failure of these systems can be attributed to the lack of relevant and satisfactory training programs provided for all levels of end users. (Lee, et al, 1995; Nelson and Cheney, 1991; Udo and Davis, 1992) Training is an on-going effort by the NAVAIR training team. In addition to conducting training for data analysts located at Patuxent River, site

visits to users located at other bases have been and are being conducted.

NAVAIR 3.6.2 continues to advertise the coming of the LMDSS. This is accomplished through the web-site and frequent presentations on the state of the application. As the training team continues to reach more potential users, awareness of its existence will increase.

As pointed out in the Findings Chapter there is a basic discontinuity between the survey respondents' perception of the data available under LMDSS/NALDA II and what will actually be available. When the LMDSS and NALDA II are fully on-line, all of the data available with NALDA I will be accessible.

The way that the LMDSS has been advertised on its Web page since becoming available via the Web has contributed to this confusion. The LMDSS Web page does not identify the application as being a prototype. It does not identify the database as being not fully loaded. This has led some respondents to believe that what they currently see is what they will ultimately get. In actuality, the stated information needs from the questionnaires are provided by the LMDSS as discussed in part D of this chapter.

It is important to overcome this perception. End users need to regard the information systems they are using and

the information provided by the IS as relevant and useful for their job performance, if they are to accept such systems. (Lee, et al., 1995; Gatian, 1994)

In the domain of DSS, the fundamental role of computer support is to assist people in reaching decisions about the course of action to implement in a particular problem situation. A user must reach a cognitive state where he understands the issues sufficiently well to choose to act or not. The computer tools must be designed to provide this fundamental layer of support to the user. The user has many things at stake - position, reputation, and self-image - and as such will rarely be willing to treat the computer as a black box, which tells him what course of action to implement. (Fedorowicz and Manheim, 1986) With this in mind, the issues of data validity and data summarization/origin must be addressed.

While the distrust of the data validity is not unique to the LMDSS or NALDA II, it is a real as well as perceived problem. Additional training at the data input source, continued development of NALCOMIS Validation Specifications, and pursuit of Automated Maintenance Environment (AME) initiatives are all possible means of improving data validity.

A thorough understanding of the origin and derivation of data is necessary if users are to trust and fully utilize the data resource (Brackett, 1996). With the exception of the Cost Analysis module, the algorithms for deriving the data and the data sources are not explicit. There is an on-line data dictionary available, but in our opinion, it adds little or no clarity to the subject.

The lack of consistency between outputs under NALDA I and LMDSS/NALDA II should also be explained to the users. Preprocessing, NALCOMIS Validation Specifications, and the use of Most Probable Logic have all improved data accuracy, but in doing so created differences between outputs. The sources of these differences need to be explicit to the user.

When people understand the content and meaning of all data, the use of those data to support current and future decision needs is limited only by people's imagination. Improve the quality of information relative to timing, accuracy, relevancy, objectivity and understandability and the quality of the resultant decision making should be improved. (Stephenson, 1986; Gatian, 1994)

C. LOGISTICS CONCERNS

The logistics managers identified the following as the logistics concerns they work with most frequently (five or more respondents work with them weekly or daily).

- Data, reports requirements - 87%
- Supply support, spares - 87%
- Maintenance planning - 63%
- Readiness degraders - 63%
- Configuration Management - 63%
- Support equipment - 63%

Technical data is one of the four areas identified to reduce costs as presented in the Affordable Readiness Proposed Metrics. Spares and support equipment are elements of inventory, which is identified as another area to reduce costs. Readiness degrader analysis is central to reliability-based logistics and trigger-based item management that are used to implement the sustainment element of Affordable Readiness. (see Appendix A)

Supply support, configuration management, support equipment, maintenance planning, and level of repair analysis are all specifically addressed as elements of total cost of ownership, maintenance concept, standardization, and supportability. These four factors are identified by

ASN(RD&A) as those that must be considered to sustain support and reduce costs. (see Appendix C)

Logistics managers identified the following logistic concerns as those they work with least frequently (five or more respondents never or infrequently work with them).

- Facilities, location - 75%
- Facilities, requirements - 63%
- Transportation, packaging or storage - 63%
- Failure mode, effects and criticality analysis - 63%
- Human factors concerns - 63%

Intuitively, the location of facilities is of little concern to logistics managers because there is little opportunity to influence this decision. Examining the influences surrounding military base closures and realignments gives us a context in which to appreciate the limitations of an input by an individual APML or PMA to influence this factor. Additionally, we understand why logistics managers infrequently work with facility requirements because this is only a concern during system acquisition, upgrade, or relocation. It is not a concern that impacts every stage of the life cycle, as other concerns do.

Specific program transportation and handling requirements are derived from the maintenance concept and

standardization factors (Blanchard, 1992). The Navy has a mature and responsive transportation, distribution and storage system. Logistics managers are more concerned with the maintenance concept concerns (maintenance planning, level of repair analysis, local repair versus transport to repair and return) and standardization concerns (configuration management and interchangeability) that contribute to transportation, packaging and storage concerns. The Navy transport and storage system imposes constraints (weight limits, cubic space limits, hoist point or shock requirements) within which the APML must work. We understand why a logistics manager will focus on the contributing concerns rather than fixed constraints.

Failure mode, effects, and criticality analysis (FMECA) is a design tool and analysis method used to tailor the complexity of the design, identify possible system failures, the causes of these failures, the effects of the failure on the system, and the criticality in terms of safety and mission accomplishment (Blanchard, 1992). A logistician who is involved with the early development of a system will work with this concern, but logisticians who do not get a voice in design will not, nor will those who are working with sustaining existing systems.

The objective of human factors analysis is to assure compatibility between the system physical and functional design features and the human element in the operation, maintenance, and support of the system. Human factor analysis is an integral part of overall system analysis. Operator and maintenance personnel requirements, and training program needs evolve from an iterative process of evaluation, system modification, and reevaluation. (Blanchard, 1992) Human factors concerns are more directly associated with engineering design and performance analysis efforts. As logistic concerns become more integrated with engineering design and performance concerns we can expect human factors requirements and criteria will increase in importance.

D. JOB INFORMATION NEEDS

Table VII-1 lists information elements indicated to be the most useful in performing the APML job. All of the elements presented in the questionnaire were useful to some degree to someone and there was no element added by a respondent. The elements included in the questionnaire but not listed in the table, are those that the respondents did not consistently indicate as either slightly useful or

extremely useful (five or more respondents; four or more for engine elements).

The LMDSS provides information for each of the identified elements except *Candidate Identification: Wait Time Maintenance Impact* and *Average Days to Receipt* which are under development. As discussed in the Data Quality section of Chapter VI, the only aircraft cost data for Maintenance Level 3 (depot) in the database is aggregate cost. It is not broken out by TMS other than engine overhaul cost data. The *Reference Information: Production Load and Run Statistics* element provides information on the LMDSS not aviation programs. Respondents indicated the element is useful, but we believe the question may have falsely led them to believe it was for aviation programs not the LMDSS. The respondents did not use the LMDSS, this reference element was listed among aviation system reference elements, and respondents were not asked to clarify one reference information element from the other. *Engine Information* elements did not pertain to the response received from the Support Equipment APML.

The LMDSS *Trend Analysis* module is count-based and does not include graphics capabilities. To perform a regression analysis or analysis of possible cause and effect relationships the LMDSS data must be further manipulated

Summary Data; End Item
Summary Data; Organization
Summary Data; Beyond Capability Maintenance (BCM) Report
Reliability Summary Parameters
Supportability Summary Parameters
Cost Summary Parameters
Emerging Problems
Common Equipment
Trend Analysis (Problems and Causes)
Component and/or End Item Cost Data, specifically: Annual Operations and Support Costs
Component and/or End Item Cost Data, specifically: Labor Cost History
Component and/or End Item Cost Data, specifically: Item Value to Depot Repair Cost
Component and/or End Item Cost Data, specifically: Budget Analysis (OP-20 Report)
Component and/or End Item Cost Data, specifically: Inflation Factors
Component and/or Ene Item Cost Data, specifically: Item Value to Labor Cost
Candidate Identification Function, specifically: Wholesale System Demand
Candidate Identification Function, specifically: Material Issue Trends
Candidate Identification Function, specifically: Supply Synopsis
Candidate Identification Function, specifically: Wholesale System Investment
Candidate Identification Function, specifically: Average Customer Wait Reports
Candidate Identification Function, specifically: Backorder History Reports
Candidate Identification Function, specifically: NAVICP NSN Snapshot
Candidate Identification Function, specifically:
Mean Flight Hour Time Between Failure (MTBF) Report
Candidate Identification Function, specifically: Wait Time Maintenance Impact *
Candidate Identification Function, specifically: Average Days to Receipt *
Engine Repair Cost
Flight Hours Since Last Engine Repair
Engine Demand Forecasting
Engine Removal Trend
Reference Information: Aircraft Inventory and Fatigue Life
Reference Information: Code Definition
Reference Information: Production Load and Run Statistics**
Reference Information: Possible Courses of Action
Reference Information: NIIN/CAGE/PN Cross Reference
Reference Information: TEC information
Reference Information: Data Dictionary

notes:
Engine information elements do not pertain to Support Equipment APML.
Aircraft Fatigue Life Reference Information does not pertain to all aircraft
* indicates the LMDSS function is under development
** provides reference information for the LMDSS not PMA program

Table VII-1 Most Useful Information Elements

beyond the LMDSS application. We believe these shortcomings reduce the utility of the *Trend Analysis* function. The *Possible Courses of Action* area simply includes a checklist of actions to consider and is not tailored to a specific program or system, forecast, or available data.

E. AFFORDABLE READINESS DECISIONS

The proposed Affordable Readiness metrics discussed in Chapter II reflect efforts to more accurately capture the total cost of ownership of aviation systems. As we have discussed, cost reductions are considered in conjunction with support, readiness and safety considerations. The LMDSS is designed to be a tool to facilitate continuous action by NAVAIR logistics management teams to measurable reduce the life cycle support costs (or the total cost of ownership) of aviation systems while protecting readiness. To measurably reduce the associated costs, the LMDSS must be able to measure the associated costs. The metrics proposed by Affordable Readiness define the required measurements. The current architecture and capability of the LMDSS as a NALDA Phase II application adequately support measurement of the metrics associated with all proposed areas of Affordable Readiness except the metrics associated with safety (Class A mishaps).

The reduction in the life cycle support costs of aviation systems will take more than the ability to measure associated costs. In addition to knowing what the costs are one must be able to analyze why and have incentives to make the "right" decisions. The LMDSS has the ability to provide

useful data as defined by Affordable Readiness metrics. In addition to providing data, users must have confidence in those data. Our research did not include a comparison of the LMDSS analysis capabilities versus alternative methods of analyzing data. The perception of APMLs is the LMDSS is good at "big picture" and indicating "where to go look" but falls short of communicating details with ease or indicating "why" a system measurement is as it is (such as *what* is degrading mission capability or *why* a component is failing).

Naming an application a DSS creates certain expectations. One of those expectations is that the DSS will support all three phases - intelligence, design and choice - of the decision making process. In order for a DSS to support the intelligence phase, it must provide accurate, timely information. The design phase includes inventing, developing and analyzing possible courses of action. The analysis capability is fulfilled by being able to answer "what if" questions. The ability to suggest new alternatives is met by being able to perform goal seeking. The choice phase involves assistance in the selection of the alternative to be implemented. Generally, this is accomplished with an optimization routine.

The LMDSS fully supports the intelligence phase of the decision making process. In order to support the other

phases of the decision making process, the data must be exported to other applications that offer models or forecasting utilities. As one survey respondent commented, "The LMDSS can help answer the what, but it can't help me with the why or the how."

The LMDSS provides the facility to export data to other applications. But, if the LMDSS is to fulfill its stated purposes of providing a repeatable decision making process it should offer a standardized set of modeling and forecasting tools as *part of* the LMDSS application.

F. PROGRAM MANAGEMENT ENVIRONMENT

Because the LMDSS will not be introduced and cannot be evaluated in isolation, we briefly address the program management environment and culture to more fully complete the context of our analysis.

The LMDSS is designed to support APMLs and in turn to benefit PMAs. Navy acquisition and program management is tied closely to the planning, programming, and budgeting (PPBS) process which determines which DoD requirements get funded and which do not. Those programs that get funding survive. Those that do not perish. A GAO report of December 1996 made the following recommendations to improve opportunities to enhance DoD's Logistics Strategic Plan:

> To build on DoD's existing strategic planning efforts and to have a better chance of achieving the major logistics system improvements that its plan envisions, we recommend that the Secretary of Defense direct the Deputy Under Secretary for Logistics to (1) ensure that future logistics plans include a recognition of the magnitude of the investment that is required to accomplish the plan's goals, objectives, and strategies and (2) issue guidance to the Secretaries of the Army, the Navy, and the Air Force and the Director of DLA instructing the services and DLA on how to link their goals and budgets to the DoD logistic strategic plan's overall goals and strategies. (GAO/NSIAD-97-28, 1996)

As indicated, change to the logistics processes must compliment the organizational structure (i.e. be linked to overarching Navy goals) and adequate resources must be dedicated to turn strategy to action. The change must also consider other organizational factors such as measurements, control processes, and reward systems. Acquisition Reform initiatives direct PMAs to tailor programs, be more creative, and to consider the total cost of ownership (DoDInst 5000.2; Hickok, 1997; Fox 1997). Contrary to these directives, the predominant focus of program management remains on unit cost, schedule, and design performance (Fox, 1997; Eaton, 1997). Incentives continue to support driving down acquisition cost (unit cost), ensuring timely delivery of aviation systems (schedule), and meeting performance specifications. To measurably reduce life-cycle support costs PMAs need more than a tool with which to measure them.

As Kaminski, then USD(A&T), said when questioned what he saw as the major improvements yet to be achieved in acquisition reform:

> Probably the biggest one is really being serious about addressing life-cycle cost. That is an area that I think we still talk about today, but I do not think we have followed through with serious initiatives. I still do not believe we have sufficient incentives in place for most program managers to seriously consider the life-cycle costs of their program...The incentives are still too much in the direction of saving near-year monies, and that support costs will be someone else's problem in the out-years. (Fox, 1997)

Kaminski tied incentive problems to the budget process. A program manager has to put up near-year funds (taken from another program areas) to make improvements and then when the out-year savings are realized those funds are swept away and are not available to the program. (Fox, 1997)

A logistics analyst for the S-3 aircraft annually updates a list of Logistics Engineering Change Proposals (LECPs) that has initiatives from ten years ago. The list documents projected total cost savings to by proposed investments in engineering changes. The list is kept from year to year because the proposals remain unfunded. Scarce O&S funds continue to be spent to maintain systems that cannot be upgraded without investment that require procurement funds. The LMDSS may help identify and justify LECPs, but it will not remedy these types of problems driving up life-cycle costs.

Additionally, while PMAs are encouraged to be creative, they are discouraged from taking risks. In fact, they are expected to plan carefully to manage and mitigate risk (DoDInst 5000.2; Conrow and Fredrickson, 1996; Rudwick, 1992). DoD/DoN strategies recognize the need to change culture and well as impediments to do so (Fox, 1997; Hickok, 1997; GAO/AIMD-96-109, 1996; GAO/NSIAD-95-28, 1994; GAO/AIMD/NSIAD-94-101). The LMDSS implementation must consider DoD/DoN strategies, environment, culture, and other organizational factors.

VIII. CONCLUSIONS AND RECOMMENDATIONS

The data and information collected for this study on the effectiveness of the LMDSS to support logistic management decision-making provides ample material to draw conclusions pertinent to this study and identify areas that warrant further research.

A. CONCLUSIONS

1. The LMDSS is not a Decision Support System.

A DSS is composed of the following three interrelated components: data management, dialog management and model management. The LMDSS fully meets the data management component criteria. It meets, to some degree, all of the dialog management component criteria. The LMDSS has no modeling or sensitivity analysis capability. The LMDSS Trend Analysis module provides historical data in tabular format. Historical data is presented in a format that could support time-series forecasting, but not causal, and there is limited "what if" analysis capability. It is a relational database that improves data accessibility.

2. There are multiple user groups who will be users of the LMDSS.

User groups include IPT data analysts, FST data analysts, and Type Command data analysts. These analysts may be Navy data analysts, government employees or civilian contractors assigned within the teams.

3. The LMDSS meets information needs to implement Affordable Readiness initiatives.

The current architecture and capabilities of the LMDSS provide information and statistics associated with all proposed logistics management areas of Affordable Readiness. No additional information needs were identified by surveyed respondents. Lack of graphics, modeling and sensitivity analysis capabilities limit identification, analysis and comparison of Affordable Readiness initiatives.

4. Data quality is both a real and perceived problem.

We identified the following three data quality issues: accessibility, consistency and validity. The LMDSS improves the accessibility of data with the IDE. However, a perception exists that it will hamper or eliminate the analyst's ability to access detail data. Data consistency is adequately addressed through the LMDSS Quality Assurance process. Poor documentation at the source degrades data validity and the lack of Maintenance Level 3 (depot) cost data precludes total cost visibility.

5. The LMDSS effectiveness in measurably reducing life-cycle support costs is hampered by the environment in which aviation program management decisions are made.

The LMDSS has the capability to support decisions to reduce life-cycle support costs, but PMAs need more than a tool with which to measure life-cycle costs to reduce them. Incentives continue to support, driving down acquisition cost (unit cost), ensuring timely delivery of aviation systems (schedule), and meeting performance specifications. The current environment encourages short-term decisions that compromise life-cycle decisions. The LMDSS can help identify and justify decisions to reduce life-cycle costs, but other factors are driving up these same costs.

B. RECOMMENDATIONS

1. Incorporate a standardized set of modeling tools and sensitivity analysis as part of the LMDSS application.

To fully support the decision-making process, modeling capabilities are necessary. Providing a standardized set of modeling tools will ensure comparable analysis and comparison across aviation systems. Sensitivity analysis capabilities would allow analysts to more readily assess the impact of different decisions.

2. Incorporate graphics capability as part of the LMDSS application.

Currently, data output is available in tabular format only. A DSS should support multiple methods of presenting output. This would add flexibility to support different users' knowledge bases.

3. Enhance availability of algorithm and data source/ summarization documentation.

A thorough understanding of the origin and derivation of data is necessary if users are to trust and fully use the data resource. Adding specific data source and algorithm information to the data dictionary is warranted.

4. Expedite initiatives to improve data validity.

Data validity problems are not unique to the LMDSS and NALDA II. The Most Probable Logic function used in the data summarization improves the validity of summarized data, but poor documentation at the source precludes valid detail data. Initiatives, such as Automated Maintenance Environment (AME) and Optimized NALCOMIS are crucial to meaningful improvements in data quality.

5. Collect and provide Maintenance Level 3 (depot) detail cost data.

Lack of detail cost data from ML 3 precludes total cost visibility. Total Cost visibility is fundamental to making intelligent life-cycle cost decisions. Although placeholders exist in the LMDSS database, they cannot be used until ML 3 collects and provides this data.

6. Align Budget Process, Reward Structure, and Strategic Decision efforts to support life-cycle cost reduction initiatives.

Until the entire decision-making environment is aligned around a common goal of reducing life-cycle costs, efforts in this area will be fragmented and undermined by short-term imperatives. Program Managers must be effective advocates of total cost of ownership. In order to accomplish this, they must be encouraged to take risks and be creative when considering life cycle costs **and** they must be rewarded for doing so.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

1. Evaluate modeling tools currently being used by logistics management teams and commercial modeling tools currently available.

A comparison, analysis, and identification of the best set of standardized modeling tools will benefit efforts to

incorporate modeling capabilities to meet logistics management decision-making needs.

2. Evaluate graphics capabilities currently being used by logistics management teams and commercial graphics tools currently available.

A comparison, analysis, and identification of the best set of graphics tools will benefit efforts to incorporate modeling capabilities to meet logistics management decision-making needs.

3. Conduct a survey of the newly identified users once the LMDSS is a production system.

We selected the APMLs as targets for our study. Additional users were identified. Because the tasks and needs of different user groups vary, the information derived from this study of APMLs may not adequately transfer. Our study was also constrained by the fact that the LMDSS is still a prototype system. Evaluating the capability of the production system to meet user needs is warranted.

4. Conduct a study of data validity.

During the course of this study we identified some areas where data validity problems exist. Further research is warranted to analyze additional data validity problem

areas, assess the impact, and evaluate alternative courses of action.

5. Assess the readiness for change and develop an organizational transition plan for implementing total cost of ownership initiatives.

NAVAIR is currently attempting to change the focus from readiness at any cost to Affordable Readiness. Effective transition from one state to another is unlikely unless there is an adequate perceived need for change, the organization structure, reward system and processes are in place to support that change, and the change is effectively managed. A study of where NAVAIR is in the process, where they are going and how best to get there is warranted.

APPENDIX A: AFFORDABLE READINESS

Affordable Readiness is a business practice with four inter-related elements: flexible sustainment, sustained maintenance planning, rightsourcing, and total cost of ownership.

Flexible sustainment encourages program managers to use performance-based specifications; develop innovative, cost effective, life-cycle solutions; conduct supportability analyses; and improve reliability. It is implemented through reliability-based logistics and trigger-based item management.

Sustained maintenance planning initiatives include reliability improvements; cycle time reductions; process improvements; technology insertions; and infrastructure improvements.

Rightsourcing is defined as "selecting the most advantageous source to accomplish a specific function for a weapon system in its life cycle. Selection criteria include, but are not limited to life cycle cost, quality, reliability, safety, and effect on other programs. Specific functions may include all facets of Design, Production, Operation, Logistics Support, and Disposal of the system." (NAVAIR, 1998)

Total ownership costs include all costs associated with the research, development, procurement, operation, logistical support and disposal of an individual weapon system and the related infrastructure.

For additional readings on Affordable Readiness, reliability-based logistics, and trigger-based management see www.nalda.navy.mil, NAVAIR Logistics, Affordable Readiness Link.

APPENDIX B: INTEGRATED PRODUCT TEAM

In the context of a DoD acquisition program there are three types of IPTs: overarching IPT, working-level IPT and Program IPT.

The **overarching IPT** is formed for each program to provide assistance, and oversight as the program proceeds through the acquisition life cycle. It is composed of the PMA, Program Executive Officer (PEO), and appropriate component staff, joint staff and Office of the Secretary of Defense staff principals or their representatives.

Working-level IPTs are composed of the PMA or his representative, and the appropriate staff members who can assist the program by providing functional knowledge and expertise to the program. For major programs working-level IPTs are generally focused on a particular discipline or functional area such as supportability, testing, cost/performance or contracting. For smaller projects one working-level IPT may be focused on the entire effort. The integrated IPT is an exception to this rule. The PMA may establish an integrated IPT to coordinate the activities of the other working-level IPTs. Ideally, the integrating IPT has as part of its membership one representative from each of the working-level IPTs who act as a linking pin with his own working-level IPT. Even though these teams are focused on a particular functional area, they are still multi-disciplinary. The supportability IPT should not be a team solely of logisticians but should have representatives from the disciplines that will influence the supportability of the item.

Program IPTs are formed at the program level to manage and execute programs.

APPENDIX C: FACTORS TO SUSTAIN SUPPORT AND REDUCE COSTS

In accordance with ASN (RD&A) memorandum of 14 February 1996, the following four factors must be considered by Navy PMAs and their IPTs, Program Executive Officers (PEOs), Direct Reporting Program Managers (DRPMs), NAVAIR Systems Commanders, and the Navy Secretariat staff in establishing supportability requirements: total cost of ownership, maintenance concept, standardization, and supportability.

An accurate picture of the **total cost of ownership** and cost relationships is necessary for cost reductions. Total cost of ownership includes all costs associated with the research, development, procurement, operation, logistical support and disposal of an individual weapons system. It includes the total support infrastructure that plans, manages, and executes the weapons system over its full life. Currently, decisions focus on a specific cost element, budget line, or product line without considering the impact on the rest of the infrastructure. For example savings in depot maintenance may increase the number of systems required in the pipeline to maintain adequate resources at the operational level. Similarly, design changes may marginally improve performance but dramatically drive up support equipment costs.

The **maintenance concept** expresses the strategy for maintaining the platform and system at a defined level of readiness in support of the operational scenario. It includes preventive maintenance, corrective maintenance, and overhaul. Maintenance concepts for the platform, systems, and support equipment must consider maintainability at all maintenance levels and must be consistent.

Standardization is intended to ensure the minimal variety and optimal interchangeability of technical information, training, equipment parts, and components. Achieving standardization is often in direct opposition to the use of performance specifications and commercial or nondevelopmental items. A balance between these two ends of the spectrum is obtained by using business and technical judgement in determining how to reduce the total cost of ownership.

Supportability requirements must fully consider life cycle costs including possible short life spans resulting from technology insertions or obsolescence. Requirements must also consider the risk of service period extensions. Planning must include the post production phase. PMAs must identify the most cost effective approach to supporting the system when fielded and assure that the required support elements, data, and information are developed and acquired.

APPENDIX D: SUPPORTABILITY STRATEGY STEPS

"Contracting for Supportability" (NAVAIR, 1998) identifies five steps to be used to establish a supportability strategy for acquisition programs for new systems, major and minor modifications or upgrades, and commercial and nondevelopmental items. The following steps should be tailored for each type of acquisition program.

1. Develop Strategy and Initial Support Requirements

The APML's first action is to determine the acquisition logistics strategy consistent with the overall program acquisition strategy. Major considerations in determining the acquisition logistics strategy are the type of acquisition, system complexity, acquisition phase, availability of historic data, and time and resources available. The availability, accuracy, and relevance of experience and historical databases on similar existing systems are crucial for accomplishment of some tasks. Available databases must be examined to determine if extensive work is needed to provide focus or relevancy. The acquisition logistics strategy should be periodically reviewed and updated to reflect any changes to the program. After the initial requirements are selected, further refinement is needed to concentrate effort in high leverage areas. Specific models and associated databases may be considered and identified at this time.

2. Design Interface with Interrelated Efforts

The APML must plan how to interface logistics requirements with the engineering community. Key related programs include reliability engineering, maintainability engineering, value engineering, human systems integration, system safety engineering, and transportability engineering. The acquisition logistics program is integrated with these related programs to prevent duplication of analyses and data and to ensure that analyses are performed in a timely manner. Logistics data is sometimes based on, and should be traceable to, systems engineering activities. Design and performance information can be captured, disseminated, and formally controlled to serve as an audit trail for logistics

support planning, trade-off analyses, and documentation preparation.

3. Select Logistics Products to be Developed and Delivered

The APML must determine what acquisition logistics products are to be delivered and how they will be delivered (magnetic tape, disk, hard copy). The importance of acquiring the appropriate data must be emphasized in keeping with the evolving policies regarding specifications and standards reform and with the thrust to reduce data requirements. The right data can be critical. Unnecessary data is simply wasteful.

4. Determine Supportability Costs

After the APML has developed all tasks and data selection has been completed, he must determine the costs associated with the effort and document funding requirements.

5. Finalize Acquisition Logistics Strategy and Document in Acquisition Logistics Plan and Statement of Work

These actions are not independent, and careful review is required to ensure consistency. After the acquisition logistics plan becomes part of the procurement request for the end item, the contractor responds with his support plan. This ensures acquisition logistics will be integrated with the total acquisition program.

APPENDIX E: NALDA

NALDA has been operational from the early 1980s. It evolved from a need for improved data analysis capabilities to support Fleet aviation weapon systems management. NALDA today is the Navy and Marine Corps central aviation maintenance and logistics automated information system. It provides an on-line, integrated life cycle logistics readiness and operational weapons systems database and tools to sustain critical support analysis. NALDA is accessed and used daily by Navy/Marine aviation headquarters, fleet and field activities. This system provides accessible, comprehensive, accurate and timely aviation logistics data analysis and reporting capabilities to support fleet readiness, through sustainability of sophisticated and complex Naval Aviation weapons and associated support equipment and systems. NALDA applications encompass the logistics planning, management, administration, budgeting, and resource allocation in support of air weapon systems and related support equipment. The intent of NALDA is to support naval aviation logistics as established by the Naval Aviation Maintenance Program[7] (NAVAIR, 1997).

A. NALDA Phase I

The NALDA design has followed a phased architecture. Phase I is currently operational. The NALDA system is composed of hierarchical Data Base Management System 2000 (S2K) databases. The primary source of data is the AV3M data received via Naval Sea Logistics Command (NSLC). Secondary sources come from NADEPs and ASO. It operates on the AMDAHL 5995 mainframe located at the Defense MegaCenter in Mechanicsburg PA. The telecommunications network presently consists of local dial-up and WATS lines.

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[7] For additional information on the Naval Aviation Maintenance Program, see OPNAV 4790.2G. This instruction provides detailed requirements and guidance for all facets of the three levels of aircraft maintenance.

B. NALDA Phase II

The current NALDA Phase I architecture is characterized by several proprietary stovepipe systems. These systems often lack interfaces, and offer redundant and conflicting information. Additionally, many of the applications are non-Year 2000 compliant. Phase II will address these deficiencies.

Phase I will be migrated in two increments to a client/server architecture on the SP2 machines located at Patuxent River and employing the ORACLE RDBMS. Increment A is in work with plans to bring it on line 30 June 1998. This discussion will focus on Increment A, as this is where the LMDSS capability is introduced. NALDA II users will establish a link to a NALDA Web Page via the Internet using commercial Web browsers and telecommunications software.

NALDA II provides an Integrated Data Environment (IDE) which will include the functionality of the systems from Phase I with expanded capabilities and incorporated into new systems. The goal is to create and store data once and use it many times. Phase II will include the following: 1) a Logistics Support Analysis Record; 2) an accurate Configuration Management Information System/Joint Logistics Systems Center software for aviation weapons systems - configuration management is considered to be one of the fleet's priorities to improve readiness and safety of flight; 3) the LMDSS, the Navy's primary decision support system to achieve cost-effective logistics management, more timely (daily) receipt of fleet AV3M and configuration data, cost-effective consolidation of central, upline AV3M data systems, and the ability to access centralized fleet-wide,near real-time, operational/readiness data from NALDA; 4) Aircraft Inventory and Readiness Reporting System (AIRRS); 5) Reliability Centered Maintenance (RCM); 6) Visibility and Management of Operating/Support Cost Programs (VAMOSC); 7) Technical Data including Joint Computer Aided Logistics (JCALS) Interface; 8) Airborne Weapons Information System (AWIS); 9) Metrology Automated System for Uniform Recall and Reporting (MEASURE); 10) Affordable Readiness Metrics/Total Cost-Decision Support System (TC-DSS); 11) Level of Repair Analysis (LORA); and 12) other interfaces and applications as identified in life cycle documentation. Ultimately, the IDE, essentially a logistics data warehouse, will contain product definition, ILS acquisition, in-service management, fleet and depot maintenance, analysis, supply, cost, configuration management status reporting, and other data. All current and future NALDA applications will be

written against the single IDE data structure (NAVAIR, 1997).

APPENDIX F: QUESTIONNAIRE

This questionnaire is separated into four parts. Part One was used as part of a telephone interview. Parts Two through Four were mailed to the respondents to be filled out and then returned.

PHONE INTRODUCTION

Thank you for your contribution to the research project of Aerospace Maintenance Duty Officers LCDR Carolynn Snyder and LCDR Ellen Moore. We are currently pursuing Master of Science Degrees in Management at the Naval Postgraduate School, Monterey. Carolynn is a student in Information Technology and Ellen is a student in Material Logistics Support. We are analyzing logistics decision support in Navy aviation system program management. The quality of our review depends on your input.

Specifically, we are looking at the LMDSS system designed to facilitate continuous action by NAVAIR logistics management teams to measurably reduce the life cycle support costs of aviation systems while protecting readiness. As a NALDA Phase II application, it incorporates data from existing maintenance, flight, cost, and material data bases into a repeatable decision making process. LMDSS is designed to enable logistics managers to answer the following:

1) How am I doing? (performance versus plan)
2) What are my current and future support cost and readiness drivers?
3) What can I do about it?
4) How much will the solution cost?
5) What is the payback period?

We want to ensure LMDSS meets your needs. We intend to propose how the Navy can measure if LMDSS measurably reduces the life cycle support costs of aviation systems (LMDSS objective). This questionnaire will help us answer the following:

1) Does the LMDSS architecture have the capability of satisfying APMLs?
2) What information does an APML use to make decisions?, and
3) Does LMDSS provide that information?

date:_____

PART ONE (Phone response from LMDSS USERS AND NON-USERS)
completed by interviewer

A. Identification information:

1. Name:_____
2. Phone:_____
3. e-mail:_____
4. Address:_____
   _____
   _____
   _____

5. Job Title: _____
6. Brief description of job:

7. Do you work with new aviation systems, sustaining existing systems, or both? (circle)

B. How often do you use the following tools to perform your job? In the capacity of identifying requirements, analyzing requirements or both?

N: never	Id: identify requirements
I: infrequently	A: analyze requirements
M: monthly	B: both
W: weekly	DK: don't know
D: daily	
DK: don't know	

8. Logistic Support Analysis (MIL-STD-1388) **N I M W D/DK // Id A B/DK**
9. Raw data **N I M W D/DK // Id A B/DK**
10. Model(s) **N I M W D/DK // Id A B/DK**

if so, which one(s)?

11. Checklist **N I M W D/DK // Id A B/DK**
if so, how was it developed?

12. Intuition/experience N I M W D/DK // Id A B/DK

13. *other:* N I M W D/DK // Id A B/DK

14. Do you know what LMDSS, Logistics Management Decision Support System, is? (circle)

Yes No

15. Have you previously or do you currently use LMDSS? (circle)
Yes No

(skip next question if previous answer is No)

16. If you use LMDSS, how often? Infrequently Monthly Weekly Daily Don't Know

17. a. How often do you interface with project engineer(s)?
N I M W D/DK // Id A B/DK

b. What for?
c. How (e-mail, phone, conference, etc.):

18. a. How often do you interface with project analyst(s)?
N I M W D/DK // Id A B/DK

b. What for?
c. How (e-mail, phone, conference, etc.)

19. a. How often do you interface with those who influence the program budget?
N I M W D/DK // Id A B/DK

b. Who?
c. What for?
d. How (e-mail, phone, conference, etc.)

20. *Other:*

a. Who? N I M W D/DK // Id A B/DK
b. What for?
c. How (e-mail, phone, conference, etc.)

21. How do you measure life cycle costs?

This questionnaire has been developed for APMLs assigned to aviation system programs. Do you know of anyone else you feel would make a valuable contribution to our study, particularly anyone involved with logistics processes in aviation systems program management?

Name:
Phone:
Address:

Name:
Phone:
Address:

Name:
Phone:
Address:

(MAIL) …. personalized address

Thank you again for your contribution to the research project of Aerospace Maintenance Duty Officers LCDR Carolynn Snyder and LCDR Ellen Moore. As we discussed by phone (*date*), we are currently pursuing Master of Science Degrees in Management at the Naval Postgraduate School, Monterey. Carolynn is a student in Information Technology and Ellen is a student in Material Logistics Support. We are analyzing logistics decision support in Navy aviation system program management. The quality of our review depends on your input.

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1) Does the LMDSS architecture have the capability of satisfying APMLs?
2) What information does an APML use to make decisions?, and
3) Does LMDSS provide that information?

Please feel free to address any questions or comments to:
LCDR Ellen Moore/phone: 408-657-0891/email: eemoore@nps.navy.mil,
or LCDR Carolynn Snyder/phone: 408-393-9567/email: cmsnyder@nps.navy.mil.

The questionnaire is divided into four parts:

Part ONE: Information provided by phone (please review and provide additional comments as desired).

Part TWO: Written response from LMDSS users.

Part THREE: Written response from those who have not used LMDSS.

Part FOUR: Written response, job information needs (LMDSS users and non-users).

Please mark each section with a legible pen or pencil. Attach additional pages as required.

PART TWO (LMDSS Users)

C. How frequently do you work with the following logistics concerns? Additionally indicate if it is in the capacity of identifying requirements, analyzing requirements or both. (circle the best answer)

22. Logistic criteria as input to system design (reliability/maintainability goals/objectives)

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

23. Human factors concerns

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

24. Failure mode, effects, and critical analysis

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

25. Failure reporting, analysis, and corrective-action system

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

26. Provisioning needs/alternatives

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

27. Compatibility with existing system

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

28. Configuration Management

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

29. Training and training support

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

30. Manpower and personnel

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

31. Supply support, spares

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

32. Inventory level analysis

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

33. Transportation, packaging or storage

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

34. Test equipment

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

35. Support equipment

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

36. Computer resource support

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

37. Facilities, requirements

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

38. Facilities, location

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

39. Data, reports requirements

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

40. Maintenance planning (scheduled versus unscheduled plan)

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

41. Level of repair analysis (O versus I versus D-levels)

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

42. Operating environment issues

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

43. Cost-drivers

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

44. Readiness degraders

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

45. Cycle time to repair components

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

46. *other:*

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

47. How often do you use LMDSS?

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

**** If you do not use LMDSS then the next portion of this questionnaire has been sent to you in error. STOP NOW and call LCDR Ellen Moore/phone 408-657-0891 or LCDR Carolynn Snyder/phone 408-393-9567 for the correct questionnaire for NON-USERS.

If you do use LMDSS, please continue with the questionnaire.

D. How often do you use the following types of LMDSS queries? (circle the best answer)

48. Summary data for end items

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

49. Reliability summary parameters

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

50. Supportability summary parameters

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

51. Cost summary parameters

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

52. Trend analysis (problems and causes)

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

53. Component and/or end-item cost data, specifically: Annual Operations and Support Costs

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

54. Component and/or end-item cost data, specifically: Labor Cost History

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

55. Component and/or end-item cost data, specifically: Item Value to Depot Repair Cost

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

56. Component and/or end-item cost data, specifically: Budget Analysis (OP-20 Report)

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

57. Component and/or end-item cost data, specifically: Inflation Factors

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

58. Component and/or end-item cost data, specifically: Item Value to Labor Cost

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

59. Candidate Identification Function, specifically: Detailed Component Report

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

60. Candidate Identification Function, specifically: Wholesale System Demand

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

61. Candidate Identification Function, specifically: Material Issue Trends

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

62. Candidate Identification Function, specifically: Supply Synopsis

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

63. Candidate Identification Function, specifically: Wholesale System Investment

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

64. Candidate Identification Function, specifically: Average Customer Wait Reports

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

65. Candidate Identification Function, specifically: Backorder History Reports

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

66. Candidate Identification Function, specifically: NAVICP NSN Snapshot

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

67. Candidate Identification Function, specifically: Mean Flight Hour Between Failure Report

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

68. Engine Repair Cost

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

69. Flight Hours Since Last Engine Repair

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

70. Engine Demand Forecasting

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

71. Engine Overview

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

72. Reference Information: Aircraft Inventory and Fatigue Life

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

73. Reference Information: Code Definition

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

74. Reference Information: Aircraft Engine Installation and Ownership

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

75. Reference Information: Production Load and Run Statistics

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

76. Reference Information: Possible Courses of Action

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

77. Reference Information: Organization Codes /Job Count

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

78. Reference Information: NIIN/CAGE/Part Number Cross Reference

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

79. Reference Information: TEC Information

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

80. Reference Information: SALTS File Information

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

81. Reference Information: Data Dictionary

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

E. Please describe your experience with the following LMDSS functions? (circle the best answer)
Please include comments to clarify answers.

82. Interface

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

83. Help function

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

84. Analysis Tools

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

85. Report Presentation/format

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

86. Time required getting what is needed

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

87. Ease of getting what is needed

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

88. Training

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

89. Accessibility (when desired)

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

90. Accessibility (server access)

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

91. Accessibility (password access)

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

92. Provides the information I need

STRONGLY DISLIKE | DISLIKE | NEUTRAL | LIKE | STRONGLY LIKE | DON'T KNOW

comments:

F. Please describe your experience using the *LMDSS* data currently available. (circle the best answer)
Please include comments to clarify answers.

93. Data meets my needs

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

94. Data is accessible

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

95. Data is accurate/consistent

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

96. Data is detailed enough

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

97. The exact data meaning is clear

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

G. Please describe your experience using *other* data currently available.
(circle the best answer)
Please include comments to clarify answers.

98. Data meets my needs

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

99. Data is accessible

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

100. Data is accurate/consistent

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

101. Data is detailed enough

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

102. The exact data meaning is clear

STRONGLY DISAGREE | DISAGREE | NEUTRAL | AGREE | STRONGLY AGREE | DON'T KNOW

comments:

Please continue now with PART FOUR, Section J, Job Information Needs

Please mark each section with a legible pen or pencil. Attach additional pages as required.

PART THREE (LMDSS Non-users)

H. How frequently do you work with the following logistics concerns? Additionally indicate if it is in the capacity of identifying requirements, analyzing requirements or both. (circle the best answer)

103. Logistic criteria as input to system design (reliability/maintainability goals/objectives)

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

104. Human factors concerns

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

105. Failure mode, effects, and critical analysis

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

106. Failure reporting, analysis, and corrective-action system

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

107. Provisioning needs/alternatives

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

108. Compatibility with existing system

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

109. Configuration Management

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

110. Training and training support

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

111. Manpower and personnel

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

112. Supply support, spares

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

113. Inventory level analysis

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

114. Transportation, packaging or storage

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

115. Test equipment

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

116. Support equipment

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

117. Computer resource support

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

118. Facilities, requirements

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

119. Facilities, location

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

120. Data, reports requirements

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

121. Maintenance planning (scheduled versus unscheduled plan)

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

122. Level of repair analysis (O versus I versus D-levels)

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

123. Operating environment issues

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

124. Cost-drivers

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

125. Readiness degraders

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

126. Cycle time to repair components

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

127. *other:*

a .frequency: NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

b. capacity: IDENTIFY REQUIREMENTS ANALYZE REQUIREMENTS BOTH DON'T KNOW

128. How often do you use LMDSS?

NEVER INFREQUENTLY MONTHLY WEEKLY DAILY DON'T KNOW

**** If you use LMDSS then the next portion of this questionnaire has been sent to you in error. STOP NOW and call LCDR Ellen Moore/phone 408-657-0891 or LCDR Carolynn Snyder/phone 408-393-9567 for the correct questionnaire for NON-USERS.

If you do not use LMDSS, please continue with the questionnaire.

129. Why do you not use LMDSS? (check mark all that apply)

_____I didn't know it existed
_____My PC won't support LMDSS
_____I've received no training
_____I don't need the information LMDSS provides
_____It takes too long to get what I need
_____It's too difficult to get what I need
_____It doesn't provide me the information I need
What information do you need that isn't provided?

I. Please describe your experience using *other* data currently available.
(circle the best answer)
Please include comments to clarify answers.

130. Data meets my needs

STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE	DON'T KNOW

comments:

131. Data is accessible

STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE	DON'T KNOW

comments:

132. Data is accurate/consistent

STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE	DON'T KNOW

comments:

133. Data is detailed enough

STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE	DON'T KNOW

comments:

134. The exact data meaning is clear

STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE	DON'T KNOW

comments:

Please continue now with PART FOUR, Section J, Job Information Needs

Please mark each section with a legible pen or pencil. Attach additional pages as required.

PART FOUR (Job Information Needs)

J. Indicate how useful the following information elements are (or would be) in performing your job. If an element is not provided, please include as an addition. (circle the best answer)

135. Summary data; End Item

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

136. Summary data; Claimant

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

137. Summary data; Organization

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

138. Summary data; BCM Report

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

139. Reliability summary parameters

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

140. Supportability summary parameters

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

141. Cost summary parameters

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

142. Emerging Problems

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

143. Common Equipment

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

144. Trend analysis (problems and causes)

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

145. Component and/or end-item cost data, specifically: Annual Operations and Support Costs

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

146. Component and/or end-item cost data, specifically: Labor Cost History

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

147. Component and/or end-item cost data, specifically: Item Value to Depot Repair Cost

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

148. Component and/or end-item cost data, specifically: Budget Analysis (OP-20 Report)

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

149. Component and/or end-item cost data, specifically: Inflation Factors

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

150. Component and/or end-item cost data, specifically: Item Value to Labor Cost

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

151. Candidate Identification Function, specifically: Detailed Component Report

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

152. Candidate Identification Function, specifically: Wholesale System Demand

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

153. Candidate Identification Function, specifically: Material Issue Trends

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

154. Candidate Identification Function, specifically: Supply Synopsis

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

155. Candidate Identification Function, specifically: Wholesale System Investment

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

156. Candidate Identification Function, specifically: Average Customer Wait Reports

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

157. Candidate Identification Function, specifically: Backorder History Reports

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

158. Candidate Identification Function, specifically: NAVICP NSN Snapshot

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

159. Candidate Identification Function, specifically: Mean Flight Hour Between Failure Report

NOT AT ALL USEFUL | NOT USEFUL | NEUTRAL | SLIGHTLY USEFUL | EXTREMELY USEFUL | DON'T KNOW

160. Candidate Identification Function, specifically: Wait Time Maintenance Impact

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

161. Candidate Identification Function, specifically: Average Days to Receipt

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

162. Candidate Identification Function, specifically: Planned versus Actual Opportunity Costs

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

163. Engine Repair Cost

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

164. Flight Hours Since Last Engine Repair

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

165. Engine Demand Forecasting

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

166. Engine Overview

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

167. Engine Removal Trend

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

168. Flight Hour Since Engine Repair at Removal

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

169. Reference Information: Aircraft Inventory and Fatigue Life

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

170. Reference Information: Code Definition

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

171. Reference Information: Aircraft Engine Installation and Ownership

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

172. Reference Information: Production Load and Run Statistics

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

173. Reference Information: Possible Courses of Action

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

174. Reference Information: Organization Codes /Job Count

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

175. Reference Information: NIIN/CAGE/Part Number Cross Reference

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

176. Reference Information: TEC Information

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

177. Reference Information: SALTS File Information

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

178. Reference Information: Data Dictionary

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

179. *Other*:

NOT AT ALL USEFUL	NOT USEFUL	NEUTRAL	SLIGHTLY USEFUL	EXTREMELY USEFUL	DON'T KNOW

We value your input, thank you again for your contribution to our research.

180. May we contact you to clarify or expand the information provided?
YES NO

Please return the questionnaire by mail to the following by 27 March 1998. (in self addressed stamped envelope provided)

LCDR Ellen Moore
SMC 1689, Herman Hall
Naval Postgraduate School
Monterey, CA 93943

Please feel free to address any questions or comments to:
LCDR Ellen Moore/phone: 408-657-0891/email: eemoore@nps.navy.mil
or LCDR Carolynn Snyder/phone: 408-393-9567/email: cmsnyder@nps.navy.mil.

Please include any additional comments, concerns, or questions below or on attached pages.

APPENDIX G: QUESTIONNAIRE RESULTS

PART ONE (Phone response from LMDSS Users and Non-users)

A Identifying Information:

1 Name
2 Phone
3 email
4 Address
5 Job Title
6 Brief Description of job
7 Do you work with new aviation systems, sustaining existing systems or both?

new	existing	both
1	2	5

B How often do you work with the following tools to perform your job?
In the capacity of identifying the requirements, analyzing the requirements, or both?

8 Logistics Support Analysis (MIL-STD-1388)

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
3	4	1	0	0	0	1	1	2	1

9 Raw Data

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	1	7	0	0	1	6	1

10 Models

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
4	0	0	0	2	1	0	0	3	1

11 Checklists

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
3	0	0	0	4	0	0	0	4	0

12 Intuition/Experience

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	8	0	0	1	7	0

13 Other

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	4	2	0	1	3	2

14 Do you know what the LMDSS is?

yes	no
8	0

15 Have you previously or do you currently use the LMDSS?

yes	no
1	7

16 If you use the LMDSS, how often?

infrequently	monthly	weekly	daily	don't know
0	0	0	1	0

17 How often do you interface with project engineer(s)?

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
1	0	0	0	7	0	0	1	7	0

18 How often do you interface with project analyst(s)?

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	7	0	0	1	6	0

19 How often do you interface with those who influence the program budget?

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	3	4	0	0	0	4	3

20 How often do you interface with others?

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	2	6	0	0	0	6	0

21 How do you measure life cycle costs?

PART TWO (LMDSS Users)

C How frequently do you work with the following logistics concerns?
Additionally, indicate if it is in the capacity of identifying requirements, analyzing requirements, or both.

22 Logistics criteria as input to system design

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

23 Human factors concerns

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

24 Failure mode, effects,and ctirical analysis

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

25 Failure reporting, analysis, and corrective action system

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

26 Provisioning needs/alternatives

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

27 Compatiblity with existing systems

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

28 Configuration Management

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

29 Training and training support

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

30 Manpower and personnel

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

31 Supply support/spares

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

32 Inventory level analysis

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

33 Transportation, packaging or storage

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

34 Test equipment

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

35 Support equipment

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

36 Computer Resource support

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

37 Facilities, requirements

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

38 Facilities, location

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

39 Data, reports requirements

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

40 Maintenance planning (scheduled versus unscheduled plan)

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

41 Level of repair analysis (O versus I versus D-levels)

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

42 Operating environment issues

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	0	0	0	0	0	1	0

43 Cost-drivers

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

44 Readiness degraders

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

45 Cycle time to repair components

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	1	0	0	0	1	0

46 Other

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	0	0	0	0	0	0	0	0

47 How often do you use LMDSS?

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

48 Summary data for end items

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

49 Reliability summary parameters

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

50 Supportability summary parameters

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

51 Cost summary parameters

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

52 Trend analysis (problems and causes)

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

53 Component and/or end-item cost data, specifically: Annual Operating and Support Costs

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

54 Component and/or end-item cost data, specifically: Labor Cost History

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

55 Component and/or end-item cost data, specifically: Item Value to Depot Repair Cost

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

56 Component and/or end-item cost data, specifically: Budget Analysis (OP-20 Report)

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

57 Component and/or end-item cost data, specifically: Inflation Factors

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

58 Component and/or end-item cost data, specifically: Item Value to Labor Cost

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

59 Candidate Identification Function, specifically: Detail Component Report

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

60 Candidate Identification Function, specifically: Wholesale System Demand

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

61 Candidate Identification Function, specifically: Material Issue Trends

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

62 Candidate Identification Function, specifically: Supply Synopsis

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

63 Candidate Identification Function, specifically: Wholesale System Investment

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

64 Candidate Identification Function, specifically: Average Customer Wait Reports

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

65 Candidate Identification Function, specifically: Backorder History Reports

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

66 Candidate Identification Function, specifically: NIIN NSN Snapshots

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

67 Candidate Identification Function, specifically:Mean Flight Hour Between Failure Report

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

68 Engine Repair Cost

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

69 Flight Hours Since Last Engine Repair

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

70 Engine Demand Forecasting

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

71 Engine Overview

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

72 Reference Information: Aircraft Inventory and Fatigue Life

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

73 Reference Information: Code Definition

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

74 Reference Information: Aircraft Engine Installation and Ownership

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

75 Reference Information: Production Load and Run Statistics

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

76 Reference Information: Possible Courses of Action

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

77 Reference Information: Organization Codes/Job Count

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

78 Reference Information: NIIN/CAGE/Part Number Cross Reference

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

79 Reference Information: TEC Information

never	infrequently	monthly	weekly	daily	don't know
0	0	0	0	1	0

80 Reference Information: SALTS File Information

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

81 Reference Information: Data Dictionary

never	infrequently	monthly	weekly	daily	don't know
0	1	0	0	0	0

E Please describe your experience with the following LMDSS functions.

82 Interface

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	0	1	0	0

83 Help Function

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	0	1	0	0

84 Analysis Tools

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	0	1	0	0

85 Report presentation/format

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	0	1	0	0

86 Time required getting what is needed

strongly dislike	dislike	neutral	like	strongly like	don't know
0	1	0	0	0	0

87 Ease of getting what is needed

strongly dislike	dislike	neutral	like	strongly like	don't know
0	1	0	0	0	0

88 Training

strongly dislike	dislike	neutral	like	strongly like	don't know
1	0	0	0	0	0

89 Accessibility (when desired)

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	1	0	0	0

90 Accessibility (server access)

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	1	0	0	0

91 Accessibility (password access)

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	0	1	0	0

92 Provides the information I need

strongly dislike	dislike	neutral	like	strongly like	don't know
0	0	0	1	0	0

F Please describe your experience using the LMDSS data currently available.

93 Data meets my needs

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	1	0	0

94 Data is accessible

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	1	0	0

95 Data is accurate/consistent

strongly disagree	disagree	neutral	agree	strongly agree	don't know
1	0	0	0	0	0

96 Data is detailed enough

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	1	0	0

97 The exact data meaning is clear

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	1	0	0	0	0

G Please describe your experience using other data currently available.

98 Data meets my needs

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	0	1	0

99 Data is accessible

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	0	1	0

100 Data is accurate/consistent

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	0	1	0

101 Data is detailed enough

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	0	1	0

102 The exact data meaning is clear

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	0	0	1	0

PART THREE (LMDSS Non-users)

H How frequently do you work with the following logistics concerns?
Additionally, indicate if it is in the capacity of identifying requirements, analyzing requirements, or both.

103 Logistics criteria as input to system design

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	3	2	0	2	0	2	1	4	0

104 Human factors concerns

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	4	1	0	2	0	1	3	3	0

105 Failure mode, effects,and ctirical analysis

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	4	0	1	2	0	1	2	4	0

106 Failure reporting, analysis, and corrective action system

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	2	2	1	1	1	1	4	1

107 Provisioning needs/alternatives

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	2	2	1	1	1	1	4	1

108 Compatiblity with existing systems

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	2	1	1	2	0	0	2	3	1

109 Configuration Management

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	2	0	2	3	0	0	2	5	0

110 Training and training support

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	3	2	1	0	1	1	5	0

111 Manpower and personnel

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	3	4	0	0	0	2	3	2	0

112 Supply support/spares

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	0	3	3	0	0	1	6	0

113 Inventory level analysis

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	2	2	2	1	0	0	1	5	1

114 Transportation, packaging or storage

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	4	0	2	1	0	1	1	4	1

115 Test equipment

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	3	2	1	0	1	1	5	0

116 Support equipment

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	1	2	2	2	0	1	1	5	0

117 Computer Resource support

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	2	2	2	1	0	2	1	3	1

118 Facilities, requirements

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	4	2	1	0	0	0	2	5	0

119 Facilities, location

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	5	2	0	0	0	2	2	2	1

120 Data, reports requirements

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	1	2	4	0	0	1	6	0

121 Maintenance planning (scheduled versus unscheduled plan)

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
1	2	0	2	2	0	0	2	4	0

122 Level of repair analysis (O versus I versus D-levels)

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	3	0	2	2	0	0	1	6	0

123 Operating environment issues

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	2	2	2	1	0	0	2	5	0

124 Cost-drivers

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	2	3	0	2	0	0	2	5	0

125 Readiness degraders

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	2	1	1	3	0	1	1	5	0

126 Cycle time to repair components

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	3	2	1	1	0	0	1	5	1

127 Other

never	infrequently	monthly	weekly	daily	don't know	identify	analyze	both	don't know
0	0	1	0	1	0	0	0	2	0

128 How often do you use LMDSS?

never	infrequently	monthly	weekly	daily	don't know
7	0	0	0	0	0

129 Why do you not use LMDSS? (check all that apply)

2	I didn't know it existed
1	My PC won't support LMDSS
4	I've received no training
0	I don't need the information LMDSS provides
0	It takes too long to get what I need
0	It's too difficult to get what I need
2	It doesn't provide me the information I need
1	other

I Please describe your experience using other data currently available.

130 Data meets my needs

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	3	3	0	0

131 Data is accessible

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	0	2	3	1	0

132 Data is accurate/consistent

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	2	2	1	0	1

133 Data is detailed enough

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	2	2	2	0	0

134 The exact data meaning is clear

strongly disagree	disagree	neutral	agree	strongly agree	don't know
0	2	3	1	0	0

PART FOUR (Job Information Needs, LMDSS Users and Non-users)

J Indicate how useful the following information elements are (or would be) in performing your job.

135 Summary Data; End Item

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	2	4	1

136 Summary Data; Claimant

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	2	1	2	2

137 Summary Data; Organization

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	1	0	1	5	0

138 Summary Data; BCM Report

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	1	0	2	4	0

139 Reliability summary parameters

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	1	6	0

140 Supportability summary parameters

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	1	5	1

141 Cost summary parameters

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	1	6	0

142 Emerging Problems

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	0	7	0

143 Common Equipment

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	1	4	2

144 Trend Analysis (problems versus causes)

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	1	5	1

145 Component and/or end-item cost data, specifically: Annual Operating and Support Costs

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	0	7	0

146 Component and/or end-item cost data, specifically: Labor Cost History

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	0	7	0

147 Component and/or end-item cost data, specifically: Item Value to Depot Repair Cost

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	0	5	2

148 Component and/or end-item cost data, specifically: Budget Analysis (OP-20 Report)

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	2	3	1

149 Component and/or end-item cost data, specifically: Inflation Factors

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	3	2	1

150 Component and/or end-item cost data, specifically: Item Value to Labor Cost

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	2	3	2

151 Candidate Identification Function, specifically: Detail Component Report

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	2	0	4	1

152 Candidate Identification Function, specifically: Wholesale System Demand

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	4	1	1

153 Candidate Identification Function, specifically: Material Issue Trends

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	2	3	1

154 Candidate Identification Function, specifically: Supply Synopsis

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	1	4	1

155 Candidate Identification Function, specifically: Wholesale System Investment

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	3	2	1

156 Candidate Identification Function, specifically: Average Customer Wait Reports

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	3	3	0

157 Candidate Identification Function, specifically: Backorder History Reports

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	1	1	2	3	0

158 Candidate Identification Function, specifically: NIIN NSN Snapshots

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	1	0	2	4	0

159 Candidate Identification Function, specifically:Mean Flight Hour Between Failure Report

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	1	5	0

160 Candidate Identification Function, specifically:Wait Time Maintenance Impact

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	2	3	1

161 Candidate Identification Function, specifically:Average Days to Receipt

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	3	3	0

162 Candidate Identification Function, specifically:Planned versus Actual Opperating Costs

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	2	2	2

163 Engine Repair Cost

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	0	5	1

164 Flight Hours Since Last Engine Repair

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	1	4	1

165 Engine Demand Forecasting

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	0	4	1

166 Engine Overview

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	1	2	2

167 Engine Removal Trend

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	0	4	1

168 Flight Hours Since Last Engine Repair at Removal

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	0	3	2

169 Reference Information: Aircraft Inventory and Fatigue Life

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	1	1	1	3	0

170 Reference Information: Code Definition

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	2	2	1

171 Reference Information: Aircraft Engine Installation and Ownership

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	1	1	1	2	1

172 Reference Information: Production Load and Run Statistics

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	4	1	1

173 Reference Information: Possible Courses of Action

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	0	4	2

174 Reference Information: Organization Codes/Job Count

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	1	2	2	2	0

175 Reference Information: NIIN/CAGE/Part Number Cross Reference

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	2	4	0

176 Reference Information: TEC Information

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	1	3	3	0

177 Reference Information: SALTS File Information

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
1	0	3	1	0	2

178 Reference Information: Data Dictionary

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	4	1	2

179 Other

not at all useful	not useful	neutral	slightly useful	extremely useful	don't know
0	0	0	0	0	0

180 May we contact you to clarify or expand on the information provided?

yes	no
8	0

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